SECOND ANNUAL REPORT

OF THE

AGRICULTURAL
EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

FOR THE

YEAR ENDING JUNE 30, 1889.

BY AUTHORITY.

LANSING:
DARIUS D. THORP, STATE PRINTER AND BINDER.
1889.

UNIVERSITY OF
ILLINOIS LIBRARY
AT URBANA-CHAMPAIGN
STACKS

Learning and Labor.
LIBRARY
OF THE
University of Illinois.
CLASS. BOOK. VOLUME.
630.7 M581re 1888/89
Accession No.

Digitized by the Internet Archive
in 2014

https://archive.org/details/financialreporto1888mich

420
29

SECOND ANNUAL REPORT

OF THE

AGRICULTURAL
EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

FOR THE

YEAR ENDING JUNE 30, 1889.

BY AUTHORITY.

LANSING:
DARIUS D. THORP, STATE PRINTER AND BINDER.
1889.

STX

630.7
M58/re
1888/89
Cop. 2

INDEX.

A.

Page.

- Abbot, Miss M. M. 10
- Acid phosphate analyzed 256
- Acme strawberry described 288
  - tomato described 228
- Actinomykosis 117
- Ada raspberry described 284
- Adulteration of seeds 18
- Advance tomato, picture of 224
  - recommended 223
- Agawam blackberry 276, 278
- Agricultural College, sunshine records at 47
  - meteorological observations at 51
  - temperature record at 29
- Agriculture, Board of 9
- Agriculturist, report of 15
- Alfalfa, analysis of 182
  - at Walton 110
  - on Agricultural College farm 215
  - success on Grayling farm 25
- Alpha strawberry 288, 294
  - tomato described 227
- Alsike clover, analysis of 182
  - at Walton 108, 110
- Americus hybrid tomato described 228
- Ammonia for apple scab 20
- Ammoniated bone analyzed 256
  - superphosphate 256
- Analyses, miscellaneous 81
- Analysis of corn stalks 241
  - ensilage 181
    - etc., bulletin on 240
  - feeding stuffs 182
  - roots and vegetables 171
  - sugar beets 86
  - wheat screenings 83, 244
- Ancient Briton blackberry 276, 278
- Anger's kale 221
- Anna Foust strawberry described 288
- Annual rainfall, charts of 122
- Anschuetz, Geo. C., letter on sugar beets 85
- Anti-kalsomine Co.'s fertilizers analyzed 258
- Apfelweise tomato described 227
- Aphis (Siphonophera) avæna 92
  - mali, picture of 245
- Apiary experiments 97
  - inventory 14
- Apple, fungus on, how treated 20
  - maggot 96
  - orchard, report of 20
  - reports from South Haven on 272
  - Russian, at Grayling 106
  - scab, treatment of 20
  - tree plant louse, picture of 245
  - trees, effects of arsenites on foliage 262
- Arboretum, report on 115
- Arlington tomato described 227
- Arnold's Pride strawberry 288, 294
- Arsenic, use as insecticide 89
- Arsenites, bees killed by use in spraying 261
  - experiments with, for insects 88
  - injury to foliage by spraying with 261
  - spraying with, bulletin on 260
- Ashes, effect on potatoes 170
  - ruta bagas 174
- Au Sable experiment station 111
- Autocrat tomato described 228

B.

Page.

- Baldwin, bulletin on experiment at 265
  - experiment station 110
  - barley, report on 175
- Barometer records at Agricultural College 51
- Bay State tomato described 228
- Beal, Dr. W. J. 10
  - annual report of 104
  - bulletin by on Jack Pine Plains 265
  - bulletin, Why Not Plant a Grove? 162
- Beebe raspberry described 284
- Bee plant, Rocky Mountain 97
- Bees, breeding experiments 100
  - Cuckoo 102
  - killed by spraying trees with arsenites 261
  - queen removed during honey harvest 101
- Beetle, flea, report on 90
  - wee grain 94
- Beets for sugar in Michigan 84
  - leaves, analysis of 182
  - report on growth of 172
- Belle City feed cutter for ensilage 184
- Belmont strawberry 288, 294
- Bermuda extra early tomato described 226
- Bidwell strawberry 288, 294
- Blackberries, report from South Haven on 275
- Black Defiance strawberry described 288
  - raspberry described 284
- Blake, Wm. A., views on ensilage 192
- Board of Agriculture 9
  - to license sale of commercial fertilizers 254
- Bomba strawberry 288, 294
- Bonanza blackberry described 276
- Bone and meat fertilizer analyzed 258
- Bonner, B. B., report on stock feeding 153
- Bordeaux mixture for apple scab 20
- Boston Market tomato described 227
- Botanical Dep't disbursements 13
  - bulletin of 162
    - on Jack pine lands 265
  - inventory 14
- Botanist, report of 104
- Botany, committee of board on 9
- Boyden strawberry described 288
- Bradley's dissolved bone analyzed 258
  - fertilizers analyzed 258
- Bran, analysis of 83
- Brandywine raspberry, comments on 281, 282
- Brassica oleracea 219
- Brazilian flour, com. report on 214
- Breck's Boston market ensilage corn 210
- Breeders' Gazette on fat stock carcasses 153
- Breeding bees, experiments in 100
- Breeds, feeding steers of different 150
- Brick for silos 177
- Bright Ida strawberry 288, 294
- Brinckle raspberry, comments on 281
- Bronze foliage tomato described 227
- Brown, Thos., on Pringle's potato 219
- Brunton blackberry described 276
- Bubach strawberry 288, 294
- Buckeye ammoniated bone superphosphate 256
- Buckwheat, Japan, for bees 99
  - not good for light lands 270
  - straw, analysis of 182

34854

Page.
Buckwheat, success on Grayling farm ... 25
Buffalo superphosphate analyzed ... 256
Buildings, committee of Board on ... 9
  disbursements for ... 12
  inventory of ... 14
Bulletins, circulation of ... 11
  of experiment station ... 119
    weather ... 121
  No. 43, weather service ... 119
  No. 44, feeding steers ... 150
  No. 45, planting a grove ... 162
  No. 46, potatoes, fertilizers, etc. ... 166
  No. 47, ensilage ... 176
  No. 48, exp'ts with vegetables ... 216
  No. 49, chemical analyses ... 240
  No. 50, grain plant louse ... 245
  No. 51, enemies of ... 248
  No. 52, commercial fertilizers ... 253
  No. 53, spraying with arsenites ... 260
  No. 54, Jack pine plains ... 365
  No. 55, fruit testing ... 271
Burpee's Superior potato, picture of ... 218
Burrill & Whitman's ensilage corn ... 211
Burt strawberry ... 288, 294
Butler raspberry described ... 284
Butterfield, Hon. I. H. ... 9
  views on ensilage ... 190

C.

Cabbage ensilage, analysis of ... 182
Camaroon corn, report on ... 214
Canada kale ... 219
  Victor tomato described ... 227
Cane sugar in beets ... 86
Captain Jack strawberry described ... 288
Carbolized plaster for curculio ... 261
Carcasses of fat steers, report on ... 153
  shrinkage by hanging ... 160
Cardinal tomato described ... 227
  recommended ... 223
Carman raspberry described ... 287
Caroline raspberry, comments on ... 281
Carrot, experiment with ... 172
  leaves, analysis of ... 182
Caucasian prickly comfrey, report on ... 214
Celery grower fertilizer analyzed ... 256
Centennial raspberry described ... 284
Champion strawberry ... 288, 294
  tomato described ... 227
Chapman honey plant ... 97
Charles Downing strawberry ... 288, 295
Charts of rain fall ... 122
Chemical Dep't, bulletin of ... 240
  on commercial fertilizers ... 253
  disbursements ... 13
  inventory ... 14
Chemist, report of ... 22
Cheny, Col., strawberry described ... 288
Cherry, report from South Haven on ... 273
  tomato, picture of ... 224
  trees, effect of arsenites on foliage ... 262
Chester Co. Mammoth ensilage corn ... 211
Chicago Fat Stock Show, College cattle at ... 150
  & Grand Trunk Railway, weather signals on ... 119
  & West Michigan Railway, weather signals on ... 119
Chloroform, experiments in apiculture with ... 109
Chrysopa flies ... 251
Church's bug finish, analyzed ... 258
Circulation of bulletins ... 11
Clara strawberry ... 288, 295
Cleome integrifolia ... 97
Cleveland Dryer Co.'s fertilizers analyzed ... 256
Climax tomato described ... 228
Clothes beetle ... 92
Cloud strawberry ... 288, 295
Cloudiness records ... 51
Clover, analysis of ... 182
Clovers, success on Grayling farm ... 25
Chester tomato described ... 226
Clute, Pres. O. ... 9, 10
  Annual Report of ... 11
Colic in horses ... 116

Page.
Colonel Cheney strawberry described ... 288
Colorado Agr'l College seedling potato, report on ... 218
Comfrey, prickly, report on ... 214
Commercial fertilizers, bulletin on ... 253
Committees of Board of Agriculture ... 9
Comparative tests of varieties of ensilage corn ... 209
Composition of cornstalks ... 241
  feeding stuffs ... 182
  roots, etc. ... 171
  wheat screenings ... 244
Conger, Sergt. N. B., Annual Report of ... 119
Conqueror tomato described ... 226
Cornelia strawberry described ... 288
Controlling board, list of members ... 9
Cook, Prof. A. J. ... 10
  Annual Report ... 88
  bulletin on enemies of grain plant louse ... 248
  bulletin on grain plant louse ... 245
  bulletin on spraying with the arsenites ... 260
  Chas. B. ... 10
Cook's Favorite tomato described ... 227
Copper carbonate and ammonia for fungus on apples ... 20
Cordley, A. B. ... 10
Corn, dried or ensilaged, comparison ... 176
  ensilage, analyses of ... 181
  fodder, analysis of ... 182
  stalks, composition of ... 241
  varieties of, for ensilage ... 209
  when to cut for ensilage ... 180
Cost of feeding fat steers ... 155
Couhanzick strawberry described ... 288
Council, members of ... 10
Country Gentleman on steer feeding experiment ... 151
Covill strawberry ... 288, 295
Cow cabbage ... 221
  pea vines, analysis of ... 182
Coy's seedling potato, report on ... 216
Crandall, Chas. S. ... 10
Crawford strawberry ... 288, 295
Crepidodera cucumeris ... 90
Crescent strawberry ... 288, 294
Crimson Beauty raspberry described ... 282
  Cluster strawberry described ... 288
Criterion tomato described ... 225
Crocker Chemical Co.'s fertilizers analyzed ... 256
Crook-neck squashes crossed with scalloped ... 221
  picture of ... 222
Crops for ensilage ... 179
  sown on Grayling farm ... 24
Cross fertilization of squashes ... 221
Cuckoo bees ... 102
Curculio carbolized plaster for ... 261
  fighting ... 89
  spraying with arsenites ... 260
Curled white variegated kale ... 220
  winter kale of Halle ... 220
  mosbach ... 220
Cumberland strawberry ... 288, 295
Currant, report from South Haven on ... 279
  tomato described ... 224
  picture of ... 224
Cut of fat stock carcasses ... 154
  kale and squashes ... 220, 222
  potatoes ... 218
Cut-leaved curled kale ... 220
Cuthbert raspberry, comments on ... 281
Cutting potatoes for seed, number of eyes ... 169

D.

Daily sunshine record at Agr'l College ... 50
Dairy test, arrangements for ... 16
Dakota seedling potato, report on ... 218
Damp soils, percolation in ... 79
Daniel Boone strawberry described ... 288
Davenport, Eugene ... 10
Davis, B. F., Treasurer Board of Agriculture ... 9
Dehring blackberry described ... 276
Deitz golden yellow ensilage corn ... 209
Depth of frozen ground ... 77

Page.

- Detroit, Grand Haven & Milwaukee R. R., weather signals on 119
- Devon carcass, report and cut of 153
- Dewberry, report from South Haven on 175
- Dew strawberry described 288
- Dewey, L. H. 10
  - strawberry described 288
- Diamond soluble bone analyzed 258
- Director of weather service, report of 119
- Director's report 11
- Disbursements for year 12
- Domore raspberry described 284
- Doolittle raspberry described 284
- Dorchester blackberry described 276
- Double curled half dwarf green kale 220
- Drainage and flood, relation between 76
- Drained soils, evaporation from 79
- Drains, time of flow of 80
- Dressed beef, proportion of in different breeds 159
- Dried fodder vs. ensilage 205
- Drouth and tile drainage, relation between 76
- Dunbar, W. S., fertilizer analyzed 258
- Duncan strawberry described 288
- Dutter strawberry described 288
- Dwarf Champion tomato described 229
  - green curled kale 219
  - red curled kale 220, 222
    - picture of 220

E.

- Earhart raspberry described 284
- Earle strawberry described 288
- Early Canada strawberry described 208
  - cluster blackberry 276, 278
  - dwarf red tomato described 226
    - picture of 222
  - harvest blackberry 276, 277
  - Oxford potato, picture of 218
    - report on 217
- Eastern King raspberry described 282
- Eau celeste for apple scab 20
- Echinops sphaerocephalus 98
- Eiformige Dauer tomato described 226
- Emerald strawberry described 288
- Emery tomato described 228
- Empire superphosphate analyzed 258
- Employés, committee of Board on 9
- Enemies of wheat aphis, bulletin on 248
- English silos 188
  - walnut, report from South Haven on 274
- Ensilage, analyses of 181
  - bulletin on 176
  - compared with dry fodder 205
  - composition at different stages 240
  - corn, varieties of 209
  - crops for 179
  - experiment in feeding of 81, 206
  - in England 188
  - temperature for 185
  - views of Michigan farmers on 189
  - weighting of 186
  - when to cut corn for 180
- Entomological Dep't, bulletin on spraying 260
  - report of 88
- Erie blackberry described 276
  - comments on 278
- Euchloena luxurians, report on 214
- Eureka strawberry 288, 295
- Evaporation from drained and undrained soils 79
- Evergreens, nurserymen's prices for 164
  - transplanting 164
- Experiments feeding ensilage 206
  - on farm at Grayling 22
  - planned on Horticultural Dep't 17
  - standing committee on 9
  - with arsenites for insects 88
- Extra Early Advance tomato described 228
  - tomato described 223, 226
    - picture of 222
  - keeper potato, report on 217
  - selected tomato described 227

F.

- Fairy strawberry described 288

Page.

- Family list of strawberries 298
- Farm Dep't bulletin 150
  - on ensilage 176
    - potatoes, etc 166
  - disbursements 13
  - inventory 14
  - report 15
- Farm management, committee of 9
- Farmers' bone fertilizer analyzed 258
  - Fertilizer Co.'s fertilizers analyzed 258
- Fat steers, cost of feeding 155
  - stock show, College cattle at 150
- Faultless tomato described 227
- Feeding ensilage or dry fodder, experiment 206
  - steers, bulletin on 150
  - stuffs, analyses of 182
- Fermentation of ensilage 185
- Fertilization, cross of squashes 221
- Fertilizers used at Grayling 23
- Fescue, meadow, at Walton 108
  - success on Grayling farm 25
- Fighting curculio 89
- Filling silo 184
- Finance, committee on 9
- Fine raw bone analyzed 256
- First ripe fruit, effect of seed 224
- Fish fertilizer analyzed 258
- Flea beetles, report on 90
- Florence raspberry described 284
- Foliage injured by arsenites 261
- Forage plants, report on 213
- Forest, depth of frost line in 77
- Forestry department bulletin 162
- French, H. T. 10
- Frozen ground, depth of 77
- Frühe rothe Zwerg tomato described 226
- Fruit testing 19
  - at South Haven 271
- Fuller, Samuel L., on ensilage 194
- Fulton market tomato described 227
- Fungicides 20
- Fungus on apple, treatment for 20

G.

- Gain of fat steers in weight 156
- Galceron strawberry described 288
- Galloway carcass, report and cut of 153
- Gandy strawberry 290, 295
- Garden City superphosphate analyzed 256
- Garfield, Hon. Chas. W. 9
  - H. H., views on ensilage 194
- Garibaldi strawberry described 290
- Garrettson strawberry described 290
- Gelbe Kirsch tomato described 225
- General Grant tomato described 227
- German sugar beets, analysis of 86
- Gestreifte tomato described 226
- Gipsy strawberry described 290
- Gladden, H. P. 10
- Glatte Amerikane tomato described 228
- Glen Cove tomato described 228
- Glendale strawberry 290, 295
- Glidden, Hon. A. C. 9
- Golden Beauty ensliage corn 210
  - Queen tomato 223, 227
  - Trophy tomato described 227
- Goldsmith strawberry described 290
- Gold strawberry described 290
- Gooseberries, report from South Haven on 279
- Grain beetle, wee 94
  - plant louse 92
    - bulletin on 245
- Grand Rapids & Indiana R. R., weather signals on 119
- Grand Rapids, college cattle exhibited at 151
- Grand Traverse Herald, remarks on Walton Station 107
- Grange, Dr. E. A. A. 10
  - annual report of 116
- Grapes, report from South Haven on 273
- Grasses and clovers on Agr'l Coll. farm 215
  - at Agr'l Coll. experiment station 113
  - marsh, analysis of 82
  - sown at Grayling 104
- Grayling, botanical experiments at 104

Page.

- Grayling, bulletin on experiment at 265
  - experiment farm, report on 22
  - grasses sown at 104
  - rainfall at 28
  - soil temperatures at, record of 36
  - station, disbursements 13
- Green fodders, analyses of various 182
  - Gage tomato 223, 226
  - midge 248
- Gregg raspberry described 284
- Grove, why not plant a 162
- Gulley, A. G., on Pringle's potatoes 218

H.

- Hackwood Park Prolific tomato described 227
- Haltica chalybdea 90
- Hampden strawberry described 290
- Hansell raspberry, comments on 280
- Harrison, bulletin on experiment at 265
  - experiment station 110
- Hathaway Dent corn for ensilage 212
  - Excelsior tomato 223, 228
  - strawberry described 290
- Haverland strawberry 290, 295
- Hay, analyses of 182
- Heating of ensilage 185
- Henderson strawberry described 290
- Herald, Grand Traverse, on Walton station 107
- Hereford carcass, report on 153
- Herstine raspberry, comments on 281
- Hilborn raspberry described 284
- Hoffman strawberry described 290
- Holstein carcass, report on 153
- Homestead superphosphate analyzed 258
- Honey plants 97
  - testing of 100
- Hopkins raspberry described 284
- Horticultural Dep't, bulletin on fruit testing 271
    - potatoes 216
  - disbursements 13
  - experiments planned 17
  - inventory 14
- Horticulture, committee of board on 9
- Horticulturist, report of 17
- Hundert Tagige Tomato described 226
- Hundred days' tomato described 226
- Hovey tomato described 228
- Hubbard's curled leaf tomato described 226
- Humidity records at Agricultural College 51
- Hungarian grass hay, analyses of 182
  - not good for light lands 270
  - success on Grayling farm 25
- Hybridizing squashes 221
- Hybrid squash, picture of 220

I.

- Ignotum tomato 224, 228
  - picture of 224
- Illinois State Board of Agriculture report on stock feeding experiment 152
- Illustrations of fat stock show carcasses 154
  - kale and squashes 220, 222
- Illustration of potatoes 218
  - tomatoes 222, 224
- Imboden, J. G. report of, on stock feeding 153
- Indiana raspberry described 284
  - strawberry 290, 294
- Ingwersen, C. G., report on steer feeding 153
- Insects and potato scab 91
- Inspection of commercial fertilizers, law for 253
- International superphosphate analyzed 258
- Inventory 14
- Italian rye grass at Walton 108
- Itasca strawberry 290, 295

J.

- Jack pine plains, bulletin on 265
- James, Dr. E. J., remarks on forestry 162
  - Vick strawberry 292, 297
- Japan buckwheat 99
- Jarvis drill phosphate analyzed 258
- Jaune Grosse Lisse tomato 223, 227
- Jenkins, Dr. E. H., analyses by 171
  - analysis of ensilage 182

Page.

- Jersey carcass, report on with cut 153
  - Queen strawberry described 290
- Jessie strawberry 290, 295
- Jewell strawberry described 290
- Johnson, Miss A. A. 10
  - Prof. Samuel 10
    - annual report of 15
    - bulletin on potatoes 166
      - ensilage 176
- Johnstone's Sweet raspberry described 284
- Jucunda strawberry described 290
- June eating potato, report on 217

K.

- Kaffir corn, report on 214
- Kale, bulletin on 216
  - varieties of 219
- Kedzie, F. S. 10
  - Robert C. 10
    - annual report of 22
    - bulletin on commercial fertilizers 253
    - bulletin on ensilage, etc. 240
    - meteorological observations 51
- Kellogg raspberry described 284
- Kentucky strawberry, note on 296
- Key's Early Prolific tomato described 226
- King Humbert tomato described 225
  - of the Earlies tomato described 226
- Kittatinny blackberry 276, 278
- Knox blackberry described 276
- Kransblätter tomato described 226

L.

- Lady-bird beetles, value of 250
- Lady Rusk strawberry described 290
- Lands belonging to station 14
- Large leaved stock kale 221
  - red tomato described 226
  - yellow improved tomato described 227
- Law for analysis of commercial fertilizers 253
- Lawton blackberry 276, 278
- Leaming Yellow Dent, ensilage corn 211
- Learned, C. G., and J. R., views of on ensilage 196
- Library disbursements 13
- Licensing commercial fertilizers, law for 253
- Lida strawberry 290, 296
- Lincoln, D. S., on Pringle's potatoes 218
- Lister's agr'l chem'l works, fertilizer analyses 258
- Lister's success phosphate analyzed 258
- List of grasses at Agricultural College experiment station 113
- List of grasses sown at Grayling 104
  - strawberries for family 298
    - market 298
- Little Gem tomato described 227
  - No. 10 strawberry described 290
- Live weight in proportion to dressed meat 160
- Livingston Co., sugar in beets from 86
- Livingstone's Beauty tomato described 228
- Lockwood, E. L., views on ensilage 196
- Logan strawberry 290, 296
- London purple, spraying with 89
  - bulletin on 260
- Longfellow strawberry described 290
- Loudon's No. 15 strawberry described 290
- Louise strawberry 290, 296
- Louse in grain plant 92
- Luce, Gov. C. G. 9
- Lucerne, analysis of 182
  - on Agricultural College Farm 215
- Lucretia dewberry described 276
- Lumpy jaw, report on 117
- Lycopersicum esculentum 225
  - pimpinellifolium tomato 224
- Lyon, T. T., arrangement made with 20
  - report on fruit testing 271

M.

- Maggie strawberry 290, 296
- Maggot, apple 96
- Mammoth cluster raspberry described 284
  - strawberry 290, 296
- Manchester strawberry 290, 296

Page.
Mangels, report on growth of 172
Mapes' fertilizer, effect on rutabagas 174
  potato fertilizer, effect of 170
Marl used on Grayling farm 23
Market Champion tomato described 227
  list of strawberries 298
Marlboro raspberry, comments on 281
Marsh grass, analysis of 82
  hay, analysis of 243
Martha strawberry described 290
Maximum sunshine temperatures at Agr'l Coll. 47
Mayflower tomato described 228
May King strawberry 290, 296
Mayo, Dr. N. S. 10
McCreery, Hon. Wm. B. 9
Meadow Fescue at Walton 108
Mellissa honey plant 98
Members Board of Agriculture 9
Meredith raspberry described 202
Merrill, Fifield & Co., views on ensilage 197
Meteorological observations at Agr'l Coll. 51
Miami strawberry described 290
Michigan Carbon Works' fertilizers analyzed 258
  Central R. R., weather signals on 119
  farmers' views on ensilage 189
  Early raspberry described 282
  rainfall, charts of 124
  State Board of Agriculture 9
Mikado tomato described 228
Milch cows, ensilage for 206
Millet, not good for light land 270
  success on Grayling farm 25
Miner strawberry 290, 296
Minimum sunshine temperature, record of at Agr'l Coll. 47
Minnewaski blackberry 276, 278
Mixing old seeds with new 19
Moisture in soil, per cent of at Agr'l Coll. 27
  Grayling 27
  relation to cultivation 26
Monmouth strawberry described 290
Moore, C. F., views on ensilage 198
Moore's Prolific strawberry 292, 296
Moss, reindeer, analysis of 83
Mount Vernon strawberry 292, 296
Mrs. Cleveland strawberry described 292
Mulberries, report from South Haven on 274

N.

Nemaha raspberry described 284
Nevada blackberry described 276
New Dominion strawberry described 292
  French Upright tomato described 228
  Jersey tomato described 228
  Oxford potato, picture of 218
  Queen potato, report on 217
  red apple tomato described 228
  rival ammoniated superphosphates analyzed 256
New Rochelle raspberry described 284
  white apple tomato described 227
  Yorker potato, picture of 218
N. Y. Market tomato described 227
Niagara grape at Grayling 106
Nicanor strawberry described 292
Nisbit's Victoria tomato described 225
Normal temperature 122
Norman strawberry described 292
Northwestern Chemical Co.'s fertilizers 258
Northwestern Fertilizer Co.'s fertilizer 256
Nurserymen's prices for evergreens 164
Nuts, report from South Haven on 274

O.

Oakes, Michael, report on steer feeding experiment 152
Oat fodder, analysis of 182
Oats, bulletin on 166
  experiment with 144
  not good for light land 270
Observations, meteorological 51
Officers of the station 10
Office's disbursements 13
Ohio Centennial strawberry described 292
Ohio raspberry described 284
  seed maker fertilizer analyzed 256
  strawberry described 292
Old Ironclad strawberry described 292
  seeds mixed with new 19
Ontario strawberry 292, 296
Optimus tomato described 228
Orange Judd Farmer on steer feeding 151
Orangefield tomato described 225
Orchard, fungus in, how treated 20
  grass hay, analysis of 182
  on Agricultural College farm 215
Oscoda, bulletin on experiment at 265
  experiment station 111
Outlying station disbursements 13

P.

Palm kale 221
Palmer, Hon. O. 9
  raspberry described 284
Paragon tomato 223, 228
Parasites on plant lice 247
  wheat aphis 248
Parasite squash bug 95
Paris green, bulletin on spraying with 260
  spraying with 89
Parker Earle strawberry 290, 297
Parrish White Dent ensilage corn 211
Parry strawberry 292, 297
Pastures, poisoning by spraying trees 263
Peas, success on Grayling farm 25
Peach, report from South Haven on 273
  tomato described 228
  trees, effect on foliage of arsenites 262
Pearl strawberry 292, 297
Pear, report from South Haven on 272
  shaped tomato described 225
  picture of 224
  tree, effect of arsenites on foliage 262
Peebles, A. B. 10
Percentage of humidity at Agr'l Coll 51
Percolation in damp soils 79
Perfection tomato 223, 228
Perennial rye grass, success of on Grayling farm 25
Phelps, Edwin, on ensilage 199
  strawberry described 292
Philadelphia raspberry described 282
Philotreta vittata 90
Photograph of fat stock carcasses 154
  kale and squashes 220, 222
  potatoes 218
  tomatoes 222, 224
Prickly comfrey, report on 214
Picture of fat stock carcasses 154
  kale and squashes 220, 222
Pineapple strawberry described 292
Pine plains, bulletin on 265
Piper strawberry described 292
Plant lice, reproduction of 246
  louse, grain, bulletin on 245
Planting forest trees, bulletin on 162
Plaster, effect on potatoes 170
  rutabagas 174
  used on Grayling farm 23
Plum, protection from insects 261
Plums, report from South Haven on 273
Plum tomato, picture of 224
  tree, effect on foliage of arsenites 262
Poire tomato described 225
Poisoning pastures by spraying trees 263
Pontiac, Oxford & Port Austin R. R., weather signals on 119
Port Huron & Northwestern R. R., weather signals on 119
Port Huron Div. of Grand Trunk, weather signals on 119
Potato and hop superphosphate analyzed 256
  bulletin on 166
  bulletin of Horticultural Dept. on 216
  eyes to cut for seed 169
  fertilizer analyzed 256
  fertilizers, effect of 170
  leaf tomato described 228
  not good for light land 270
  scab and insects 91

Page.

- Potato, varieties, relative yield of 168
- Precipitation charts 122
- Precursor tomato described 226
- President strawberry described 292
- Pressure of vapor of water 51
- Prince of Berries strawberry described 292
- Pringle's hybridized potato, report on 218
- Prize Bell tomato described 227
- Pure ground bone analyzed 256
- Puritan tomato described 228

Q.

- Queen bees, removing during honey harvest 101
  - City phosphate analyzed 256
  - of tomatoes described 225
  - tomato, described 227
    - picture of 222
- Quinces, report from South Haven 273

R.

- Railroads carrying weather signals 119
- Rainfall at Agricultural College 51
    - Grayling 28
  - charts 122
- Rancocas raspberry 282
- Raspberries, report from South Haven on 280
- Receipts for year 12
- Record of soil temperature at Agr'l Col. 29
    - Grayling 36
  - sunshine at Agr'l Coll. 50
- Red cherry tomato described 225
  - clover, success on Grayling farm 25
  - Flanders kale 221
  - Jersey Cavalier kale 221
  - Marrow kale 220
  - Plum tomato described 225
  - top on Agr'l Coll. farm 215
  - Valentia cluster tomato described 227
- Reder raspberry, comments on 281
- Regulation of sale of commercial fertilizers 253
- Reindeer moss, analysis of 83
- Relation of tile drainage to floods 76
- Reliance raspberry described 282
- Removing queen bees during honey harvest 101
- Report of agriculturist 15
  - apple orchard 20
  - botanist 104
  - chemist 22
  - director 11
  - entomologist 88
  - horticulturist 17
  - secretary and treasurer 12
  - veterinarian 116
- Reproduction of plant lice 346
- Reynolds, H. G., annual report 11
    - secretary 9, 10
- Richmond strawberry described 292
- Rochester tomato described 228
- Rocky mountain bee plant 97
- Roots, analyses of 171
  - bulletin on 166
- Rothe Birne tomato described 225
- Rouge grosse hative tomato described 226
- Rouge naine hative tomato described 226
- Rubus canadensis, report on 275
  - villosus, report on 275
- Rural New Yorker potato, report on 217
- Russian trees at Grayling 106
- Rutabagas, report on growth of 172
- Rye fodder, analysis of 182
  - grass at Walton 108
    - success on Grayling farm 25
  - success on Grayling farm 25

S.

- Salaries 13
- Sale of commercial fertilizers, law for regulation of 253
- Salt, effect on potatoes 170
    - rutabagas 174
  - used on Grayling farm 23
- Sanborn, J. P., views on ensilage 202
- Sandy soil fertilizer analyzed 256
- Sayman's early blackberry described 276

Page.

- Scab on apples 20
  - potatoes 91
- Scarlet Gem raspberry described 282
- Scalloped squashes crossed with crook-necked 221
- Scoville tomato described 228
    - picture of 222
- Screenings, analysis ofwhae t 83, 214
- Sea fowl guano analyzed 258
- Secretary's report 12
- Seed, adulteration of 19
  - from first ripe fruit, effect of 224
  - potatoes, how many eyes 169
  - testing, report on 17
- Seneca Queen strawberry 292, 297
- Serradella, analysis of 182
  - report on 213
- Shaffer raspberry described 284
- Sharpless strawberry 292, 297
- Sheep fodder, report on 214
- Shirt's strawberry described 292
- Shorthorn carcass, cut of 153
- Shrinkage of carcass in butchering 160
- Silo, brick for 177
  - bulletin on 176
  - filling of 184
  - stone for 177
- Silos, number of in England 188
    - United States 188
- Silvanus surinamensis 94
- Siphonophora avenæ 245
- Skeels, F. E., on Pringle's potatoes 218
- Skene, Geo., on Pringle's potatoes 218
- Snowball tomato described 227
- Snowfall at Agricultural College, record of 51
- Snyder blackberry 276, 278
- Soil, evaporation from drained and undrained 79
  - moisture, per cent of at Agr'l College 27
      - Grayling 27
    - relation to cultivation 26
  - percolation in damp 79
  - temperature at Agr'l College 29
      - Grayling 36
- Sorghum, analysis of 182
- Souhegan raspberry described 284
- Southern ensilage corn 211
- South Haven sub-station, report of 20, 271
- Spasmodic colic in horses 116
- Spergulum maxama, report on 214
- Spraying trees, poisoning pastures by 263
  - with arsenites 89
    - bees killed by 261
    - bulletin on 260
- Springfield raspberry described 284
- Spurry at Walton 108
  - success on Grayling farm 25
- Square bone analyzed 256
- Squash bug parasite 95
  - bulletin on 216
  - cross fertilization of 221
  - hybrid, picture of 220, 222
- Standing committees Board of Agriculture 9
- State Board of Agriculture 9
    - to license commercial fertilizers 254
- Station officers 10
  - tomato described 229
- Steers, bulletin on feeding of 150
- Stocking, William, report on stock feeding 153
- Stock kale 221
  - show, college cattle at 150
- Stone for silos 177
- Strawberries at Walton 110
  - family list of 298
  - market list of 298
  - reports from South Haven on 287
- Sub-station at South Haven, report of 20
- Sucker State strawberry described 292
- Sugar beet growing in Michigan 84
  - reports on growth of 172
- Summit potato, report on 218
  - strawberry 292, 297
- Sunapee strawberry described 292
- Sunset tomato described 227
- Sunshine record 50
  - temperature, record of 46
- Superb raspberry, comments on 281

Page.
Superior bone analyzed 256
Surprise raspberry described 282
strawberry described 292
Sutton potato, report on 218
Sweet ensilage 185
Martin L., views on ensilage 201
Sweet's ensilage corn 212
Synopsis of varieties of tomato 224
Syrphus flies 251

T.

Taft, Prof. L. R. 10
annual report of 17
bulletin on fruit testing 271
potatoes, etc. 216
Tall fescue, success on Grayling farm 25
green curled kale 222
red curled kale 220
Scotch kale 220
Tawas City sugar beet analysis 84
Taylor blackberry described 276
Teller, G. L. 10
Temperature for ensilage 185
in sunshine, record of at Agr'l Coll. 46
of soil at Agr'l Coll. 29
Grayling 36
normals 122
Teosite, report on 214
Testing honey 100
seeds, report of 17
Tests of vegetables and fruits 19
Thorburn potato, report on 218
Thousand-headed kale 221
Thunder storms, number of at Agr'l Coll. 51
Tile draining and relation to floods 76
Time of flow of field drains 80
Timothy hay, analysis of 182
Tomatoes, bulletin on 216
illustrations of 222, 224
seed from first ripe fruit, effect of 224
varieties of described 224
recommended 223
yield of tabulated 230
Tom Thumb tomato described 226
Townsend strawberry 292
Traverse Herald, remarks on Walton station, 107
Treasurer's report 12
Treeplanting, bulletin on 162
Trichopoda pennipes 95
Triomphe de Gand strawberry described 292
Trophy tomato described 227
Truitt strawberry described 292
Trypeta pomonella 96
Turkenbund tomato described 226
Turk's Cap tomato described 226
Turner, Hon. James M., views of on ensilage 203
raspberry, comments on 281
Turner's hybrid tomato described 228
Turnips, success on Grayling farm 25
Twenty-six dollar phosphate analyzed 256
Tyler raspberry described 284

U.

Undrained soils, evaporation from 79

V.

Varieties of ensilage corn compared 209
kale 219
tomatoes described 224
recommended 223
yield of 230
Vegetable bone phosphate analyzed 256

Page.
Vegetables, analyses of 171
tests of 19
Veterinarian, report of 116
Veterinary, committee of Board on 9
department, disbursements 13
inventory 14
Vicia villosa, report on 214
Vick strawberry 292, 297
Voluntary observers of weather 120
Volunteer tomato described 228

W.

Wallace blackberry 276, 278
Walton & Whann Co.'s fertilizers analyzed 258
bulletin on experiments at 265
diagram of plats at 265
sub-station at 107
Warfield strawberry 292, 297
Warren strawberry described 292
Warwick strawberry described 292
Weather crop bulletin 121
service department, report of 119
signals, railroad 119
Weber, Rudolph, report on steer feeding experiments 153
Wee grain beetle 94
Weighting ensilage 186
Weight of fat steers 157
Wells, Hon. Franklin, President of Board 9
Western Reserve Fertilizer Co., analyses 258
Triumph blackberry, comments on 276, 278
Union Chemical Co. fertilizers 258
West Michigan Fair, college cattle at 151
Wheat aphis, bulletin on enemies of 448
bran, analysis of 83
louse parasites, bulletin on 248
not good for light land 270
screenings, analyses of 83, 244
Whip worms in horses 116
White apple tomato recommended 223
arsenic objectionable as an insecticide 89
clover, success on Grayling farm 25
Giant of Normandy ensilage corn 210
Marrow kale 220
turnips, success on Grayling farm 25
Why not plant a grove? bulletin on 162
Wilson blackberry, comments on 278
early blackberry described 276
Jr. blackberry described 276
strawberry, note on 297
Windsor strawberry 292, 297
Wisconsin white dent ensilage corn 210
Wonderful strawberry described 292
Wonder of Italy tomato described 225
Woodruff strawberry 292, 298

Y.

Yellow cherry tomato described 225
Jefferson tomato 223, 227
lupine, report on 214
plum tomato described 225
Victor tomato described 227
Yield of tomatoes, table of 230

Z.

Zoological department, bulletin on grain plant louse 245
Zoological department, bulletin on grain plant louse, enemies of 248
Zoological department disbursements 12
inventory 14

AGRICULTURAL COLLEGE,
July 1, 1889.

To the Hon. CYRUS G. LUCE,
Governor of the State of Michigan:

SIR:—I have the honor to submit to you herewith the second annual report of the Agricultural Experiment Station Department of the State Agricultural College, for the year ending June 30, 1889, with supplementary papers.

Very respectfully,
HENRY G. REYNOLDS,
Secretary of the State Board of Agriculture.

MICHIGAN

STATE BOARD OF AGRICULTURE.

IN CONTROL OF THE

AGRICULTURAL EXPERIMENT STATION.

	Term expires.
Hon. FRANKLIN WELLS, Constantine, President of the Board.	1891
Hon. WM. B. McCREERY, FLINT,	1893
Hon. CHAS. W. GARFIELD, Grand Rapids,	1893
Hon. OSCAR PALMER, Grayling,	1895
Hon. A. C. GLIDDEN, Paw Paw,	1895
Hon. I. H. BUTTERFIELD, Lapeer,	1891
Hon. CYRUS G. LUCE, Governor of the State,	*Ex-officio.*
Hon. O. CLUTE, M. S., President of the College,	

HENRY G. REYNOLDS, M. S., Agricultural College, Secretary.
BENJAMIN F. DAVIS, Lansing, Treasurer.

STANDING COMMITTEES.

The President of the Board is ex-officio a member of each of the Standing Committees.

Finance:	Wm. B. McCreery, A. C. Glidden.
Farm Management:	A. C. Glidden, I. H. Butterfield.
Botany and Horticulture:	C. W. Garfield, O Palmer.
Buildings:	I. H. Butterfield, Wm. B. McCreery.
Employees:	O. Palmer, Wm. B. McCreery, O. Clute.
Veterinary Dep't.:	O. Palmer, I. H. Butterfield.
Experimenting:	O. Palmer, A. C. Glidden.

OFFICERS OF THE STATION.

O. Clute, M. S.,	Director.
Henry G. Reynolds, M. S.,	Secretary and Treasurer.
Samuel Johnson, M. S.,	Agriculturist.
L. R. Taft, M. S.,	Horticulturist.
Robert C. Kedzie, M. A., M. D.,	Chemist.
Albert J. Cook, M. S.,	Entomologist.
William J. Beal, M. A., M. S., Ph. D.,	Botanist.
E. A. A. Grange, V. S.,	Veterinarian.
Hiram T. French, B. S.,	Assistant in Agriculture.
A. A. Johnson, B. S.,	" " "
Chas. S. Crandall, B. S.,	" " Horticulture.
H. P. Gladden, B. S.,	" " "
F. S. Kedzie, M. S.,	" " Chemistry.
Geo. L. Teller, B. S.,	" " "
A. B. Peebles, B. S.,	" " "
Chas. B. Cook, B. S.,	" " Entomology.
A. B. Cordley, B. S.,	" " "
E. Davenport, M. S.,	" " Botany.
L. H. Dewey, B. S.,	" " "
N. S. Mayo, B. S., D. V. S.,	" " Veterinary Science.
M. M. Abbot,	Librarian.

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

To the State Board of Agriculture:

Work in the Experiment Station during the past year has gone forward with efficiency, and in most cases the results are of interest and of real value. The reports of the heads of the departments are herewith submitted. In some cases the results are given somewhat in detail; in others the details are given in the bulletins which have been issued during the year, or which are soon to appear. All the bulletins for the year are printed in this volume, hence any extended account of the Station work is not necessary in my report.

The excellence of the method on which our Experiment Station is organized is shown by the large amount of work done. That method is to put an important branch of experiment work in charge of one of the professors, whose long training in his specialty has given him knowledge of what needs to be done, and has taught him the best methods of going at it. This chief of a department plans the experiments in his department, and oversees the carrying them out. He is furnished with such trained assistants as are needed, who attend to the details under his direction. In our Station it has been found that the graduates of our College make the best men to be found for assistants to the heads of departments. Our main difficulty is that we cannot keep them, for their training fits them for responsible positions, and they are soon called to other fields at larger salaries. In several instances during the last two years the Station has lost valuable men in this way. In some cases their loss has been a serious drawback to the success of the year's work.

Experimentation has been in progress at the Michigan Agricultural College since the earlier years of its existence, reports of them appearing in the annual volume published by the State Board of Agriculture. After the passage of the Hatch act the Experiment Station was organized under that act, and all experiment work at the College was turned over to the Station. In the twenty-one months since our Station began work under the present organization it has published twenty-one bulletins, nearly all of which contain valuable results. Twelve of these have been published since the date of the last report. Material is prepared for several others, containing results of work in 1889. These will soon be issued. The Station bulletins now have a regular circulation of 4,500 copies. New applications for them are coming in by nearly every mail, and it is found necessary to keep the mailing list "set up," so as to add the new names. Of some of the bulletins the first edition has been speedily exhausted, and extra editions of several thousand copies have been published. Some of the leading newspapers of Michigan, and of other States, reprint the most important parts of our bulletins, and so give them a very wide circulation.

The heads of the Station staff hold meetings from time to time for consultation and discussion. By request of the Director the heads of the departments and the State Board of Agriculture will meet in joint session early in December to plan for the still more efficient prosecution of the work. It is very desirable that our plans be carefully made, that they include such research as will in the end prove of greatest value, and then that the staff and the Board of Agriculture coöperate in attaining the ends sought. The friendly interest and sympathy of the Board have thus far been all that could be desired. It is believed that such joint sessions, as the one proposed, will tend to continue and strengthen the coöperation of staff and Board, and so to maintain and increase the efficiency of the Station.

Very respectfully yours,
O. CLUTE,
Director.

AGRICULTURAL COLLEGE,
October 31, 1889.

REPORT OF THE SECRETARY AND TREASURER.

FOR THE YEAR ENDING JUNE 30, 1889.

	DR.	CR.
July 1, 1888—By balance due from U. S. Treasury on account of the 4th quarter of previous year		$3,750 00
July 17, “ —To U. S. Treasury on account of 4th quarter	$3,750 00	
Oct. 15, “ — “ “ “ “ “ “ 1st “	3,750 00	
Jan. 3, 1889— “ “ “ “ “ “ 2d “	3,750 00	
Mar. 28, “ — “ “ “ “ “ “ 3d “	3,750 00	
Nov. 30, 1888—To sale of 10 steers used in feeding experiment	786 45	
June 30, 1889—To license fees on 40 commercial fertilizers	800 00	
“ “ —To miscellaneous receipts, as per accounts filed in the office of the State Auditor General	76 19	
“ “ —By disbursements, as per vouchers filed in the office of the State Auditor General		16,662 64
“ “ —To balance due from U. S. Treasury on account of 4th quarter	3,750 00	
	$20,412 64	$20,412 64

SUMMARY OF DISBURSEMENT ACCOUNT.

Buildings—		
To Botanical Laboratory Experiment Rooms	$264 90	
Grayling Experiment Farm, Barn	108 07	
Farm Department, feed mill	136 11	
Farm Department, stalls etc.	91 65	
		$600 73
Carried forward		$600 73

Brought forward		$600 73
Salaries—		
To director	$185 83	
secretary and treasurer	333 32	
librarian	120 83	
six heads of departments	3,250 00	
twelve assistants	2,979 76	
		6,869 74
Farm Department—		
To labor	$657 86	
three young steers for feeding experiment	150 00	
eight young heifers for dairy experiment	629 30	
one Jersey bull for dairy experiment	105 00	
six pigs for feeding experiment	60 00	
feed and bedding	663 00	
fat stock show and pictures of fat steers	484 24	
freight, $64.01; traveling, $43.70; seeds, $21.24	128 95	
fertilizers, $111.16; office, $26.85; apparatus, $187.09	325 10	
		3,203 45
Horticultural Department—		
To labor	$111 14	
plants and seeds	229 89	
microscopic, photographic and chemical apparatus	271 90	
freight, $42.50; rent of ground, $51.20; fertilizers, etc., $111.95	205 65	
		818 58
Chemical Department—		
To analysis of commercial fertilizers	$329 65	
apparatus	318 34	
stove, $52.60; postage, $22; sundry, $95.99	170 59	818 58
Botanical Department—		
To labor	212 71	
microscope, lenses and apparatus	253 56	
stove, $35.40; tables, $22; cases, $62.98; seeds, $66.46	186 84	
labels, $30.15; traveling, $22.10; sundry, $60.72	112 97	
		766 08
Zoölogical Department—		
To labor	$117 75	
apiary, $74.97; seeds and fertilizers, $24.45	99 42	
microtome, $40; pressed cork and pins, $45.90	85 90	
freight, $14.21; traveling expenses, $7; sundry, $50.23	71 44	
		374 51
Veterinary Department—		
To labor	$185 50	
apparatus, $265.31; office rent, $83.68	348 99	
feed, $73.02; furniture, $21; sundry, $96.27	190 29	
		724 78
Grayling Station—		
To labor	$556 36	
traveling, $94.26; seeds, $150.58; fertilizers, $55.75	300 59	
rent of land, $40; freight, $10.87; sundry, $45.67	96 54	
		953 49
Other Outlying Stations—		
To labor	$296 75	
traveling expenses, $124.58; fencing, $80	204 58	
South Haven, $50; freight, $7; seeds, $27.40	84 40	
		585 73
Library—		
To books, $548.72; sundry, $13.92		562 64
Offices—		
To traveling expenses to fat stock show and convention	$131 74	
stationery, $44; furniture, $194.25; freight, $14.34	252 59	
		384 33
		$16,662 64

This expenditure may be more briefly summarized and classified as follows:

Salaries	$6,869 74
Wages	2,138 07
Buildings	600 73
Other property	3,217 45
Seeds and plants	507 82
Traveling expenses	573 38
Feed	736 02
Miscellaneous	2,019 43
	$16,662 64

INVENTORY.

In this inventory I find there are included four steers bred by the College and neither sold nor formally donated to the Experiment Station, viz: One Shorthorn, two Devons and one Holstein, each valued at $50. I also note, that the estimated value of the books in the library is $223.54 less than their cost, a discount of about 17 per cent.

Lands donated to the Station—		
80 acres at Grayling, fenced and improved	$1,850 00	
10 " " Harrison, " " "	300 00	
10 " " Oscoda, " " "	120 00	
		$2,270 00
Buildings—		
Experimental feed barn	$1,200 00	
Horticultural laboratory, experimental rooms	1,200 00	
Apiary	600 00	
		3,000 00
Library and offices—		
Books	$1,085 00	
4 book-cases, 4 doz. filing boxes, carpet, stationery, etc.	369 00	
		1,454 00
Farm Department—		
Implements	$140 36	
13 steers for feeding experiment	650 00	
9 heifers and 1 bull for dairy experiment	850 00	
Feed and office equipment	339 00	
		1,979 36
Horticultural Department—		
Implements	$175 00	
Microscope, camera, balances, etc.	494 25	
		669 25
Chemical Department—		
Sundry apparatus	$617 37	
Chemical and physical balances	529 20	
Horse tools on Grayling farm	146 50	
		1,293 07
Botanical Department—Microscopes and sundry apparatus		510 20
Veterinary Department—Microscopes and sundry apparatus		628 83
Zoölogical Department—		
Microscope, balances and insect cases	$279 34	
Apiary, 35 colonies of bees, tools, etc.	649 35	
		928 69
		$12,733 40

REPORT OF THE AGRICULTURIST.

[The following is that portion of the report of Prof. Samuel Johnson to the President of the State Board of Agriculture which related to the State Agricultural Experiment Station.—H. G. R., Sec'y.]

* * * * * We have sent out five bulletins from the agricultural department of the Experiment Station during the year.

No. 38.—Experiments with Varieties of Wheat and Amounts of Seed; Fertilizers for Meadow Lands.

No. 41.—Warming Water for Dairy Cows.

No. 44.—Feeding Steers of Different Breeds.

No. 46.—Potatoes, Roots and Oats; Comparison of Varieties; Different Amounts of Seed and Various Fertilizers.

No. 47.—Silos and Ensilage; Seven Years' Experience at the College; Views of Leading Farmers and Stockmen; Ensilage vs. Dried Fodder and Grain; Test of Varieties of Ensilage Corn and Forage Plants.

I take some pleasure in calling the attention of the readers of this report to the live subjects discussed in these bulletins. The work of the department will not suffer in this respect, at least, in comparison with others at home or abroad.

EXPERIMENTAL WORK.

The Farm Department experiments have been fully reported in the bulletins issued and through the agricultural press.

The steers of different breeds, to which attention has been called in former reports, were shown at the State Fair at Jackson, the next week at the West Michigan Fair at Grand Rapids and then at the Central Michigan at Lansing.

The full report of the final showing at the Fat Stock Show at Chicago will be found in bulletin No. 44. The leading farm journals gave special attention to this exhibit, the Rural New Yorker devoting an entire page to photographs of the animals slaughtered and another to notes on the experiment. The Country Gentleman said: "Decidedly *the* feature of the last Chicago Fat Stock Show, so far as its educational and practical rather than its sensational side is concerned." The Mark Lane Express, a leading English agricultural newspaper, whose editor was present at the show, gave considerable space to the report and reproduced the photographs of the meat cuts from the different carcasses.

The second lot of calves for a similar test was purchased during the summer and fall of 1888 and is well under way.

The Herefords came from Merrill & Fifield, Bay City, and Hon. Wm. Crapo, Flint, John W. Foster, Supt. A Holstein from Hon. M. L. Sweet, Grand Rapids; one Shorthorn from the herd of Wm. Curtis & Sons, Addison; the Galloways from R. B. Caruss of St. Johns and Townsend & Wicks of Colby; the Devons, one Shorthorn and one Holstein were bred at the College.

The Board of Agriculture authorized the purchase of heifers for a dairy test, and two Jerseys from the herds of Hon. Isaac Marston, Bay City, and Smith Bros., Eagle, were selected. W. L. Sexton, Howell, furnished one Holstein and Westover & Seely of Bay City the other; Dwight Curtis of Addison one Shorthorn, the College one. C. M. Winslow, Secretary of the National Ayrshire Association, selected the two Ayrshires bred by Alonzo Libby, Sacarappa, Maine. They are fine specimens, and if properly cared for ought to be valuable for the purpose for which they were purchased.

A Merino lamb from Mr. Chilson of Hanover, Lincolns from G. L. Allen & Sons of Portland, and grade Shropshires raised on the College farm have been fed together in the same experiment.

Duroc Jerseys from the herd of Mr. McBride of Burton, Berkshires from Mr. Hibbard's herd at Bennington, and Poland Chinas and cross-bred Poland China and Berkshire pigs bred at the College were fed last year. A pair of Duroc Jerseys from the same herd, Berkshires from Mr. Hibbard and Poland Chinas from Mr. H. W. Riley, Greenville, were purchased for a repetition of the test and are now being fed.

Several varieties of wheat were tested in acre plats and other varieties in smaller plats. Some fifty varieties of potatoes were planted this season. The testing of varieties of ensilage corn and forage plants was continued; also with roots, oats and buckwheat. The use of different amounts of seed for the purpose of determining the amount required to produce the largest yield, and the comparative test of commercial fertilizers with our more common manures has been continued. The one acre plats of grasses stood the winter well and yielded well. The testing of grasses in not less than acre plats seems the best for experimental purposes, as in smaller plats the yields are not sufficient to fully test their feeding value. * * *

REPORT OF THE HORTICULTURIST.

To O. Clute, Director :

The report from this department will be a mere statement of the work performed, the methods and results being published in the bulletins.

On taking charge the middle of last August, the only work immediately available was the closing up, so far as was possible without records or notes of previous observations, the tests of varieties that were undertaken by my predecessor. The fruits had all been gathered, and the results that were obtained with such vegetables as escaped the early frosts were given to the public in Bulletin No. 48, entitled "Potatoes, Tomatoes, Kale and Hybridized Squashes." Careful records of the yield, and notes on the appearance of the different varieties were taken, and seed was saved for this year's planting.

The following outline of experiments to be carried on during 1889 was arranged, and preparations were made to begin the work when spring opened:

1. Tests of and experiments with seeds, to determine their purity, vitality, proper depth of sowing, and the effect on their germination of different amounts of heat and moisture.
2. Testing new and standard varieties of fruits and vegetables as to hardiness, vigor, productiveness, quality and freedom from disease; the work to be carried on both on the College grounds and by volunteer observers in different parts of the State.
3. Observations upon the hardiness and general value of the new shade trees and shrubs.
4. Experiments with fertilizers. Effect of same on the growth, hardiness, productiveness, health and quality of fruits and vegetables.
5. Studying the diseases of plants, and testing remedies for them.
6. Trial of various methods and implements of cultivation.
7. Origination of new varieties by selection and crossing.

SEED TESTING.

The seeds used in this experiment were obtained from over a dozen seedsmen, and their vitality was examined by placing them in seed-testers, in seed-boxes, and in some cases in the open ground. A comparison of the results obtained by the different methods indicate that if proper care be given, either one can be depended upon to furnish an approximately correct idea of the value of seeds. With new and plump seeds there will be little or no difference, but if the seeds are old or weak the tester will generally show a slightly higher per cent of germination. While the seed-tester is an invaluable aid to the experimenter in testing the germinating power of seeds, the seed-box or open ground, where they are sprouted under the same conditions as in actual practice, will give more reliable testimony as to their real value.

The tests made this year show several things that are of interest:

1. The seeds were, as a rule, well cleaned and free from foreign seeds. In a few cases they were mixed with other varieties.

2. No seedsman, so far as the tests went, is absolutely reliable. While all of them furnished seeds of a high character as a general rule, packets were frequently found that had a very low per cent of germination,—so low, in fact, that if any reliance had been placed upon them for a crop a failure would have resulted.

Most seedsmen claim to test their seed before sending it out, and if it does not germinate 50 to 75 per cent (varying with the kind of seed) it is not sent out, and yet we find of the Autumn Giant Cauliflower not a single seed sprouted, while the Dwarf Erfurt gave 90 per cent. The same was noticeable in lettuce, where of the Boston Curled, from Henderson, only eleven seeds sprouted, while Henderson's All the Year Round gave ninety-five plants.

In the tester the seeds of the different varieties were subjected to the same conditions identically, while in the soil they were sown in parallel rows in shallow seed-boxes. In some cases only three or four kinds, while in others as many as ten or twelve, were placed in one box.

In one instance the following results were obtained from the varieties of lettuce in one box, one hundred seeds of each kind being used.

No. of Row.	Name of Variety.	Seedsman.	Date of Vegetation.	No. Vegetating.	Notes on the Appearance of Plants.
1	Yellow Seeded Butter	Henderson	Mar. 18	92	Strong, even.
2	Tomhannock	Ely	" 18	96	Strong, even.
3	Tomhannock	Burpee	" 18	69	Somewhat uneven, rather weak.
4	Rudolph's Liebling	Vaughan	" 20	25	Weak, uneven.
5	Sugar Loaf	Gregory	" 18	85	Strong but somewhat uneven.
6	Silver Ball	Burpee	" 24	30	Very weak.
7	Oak Leaf	Burpee	" 22	16	Very weak and uneven.
8	No. 21	Vaughan	" 19	62	Rather weak.
9	Salamander	Henderson	" 18	92	Strong and even.
10	Boston Market	Henderson	" 24	28	Very weak.

The plants were sown on the 12th of March in boxes in the forcing house, the dates of vegetation were taken, and on the 29th the plants were counted and notes on their condition made. Twenty-seven other varieties of lettuce were grown, and these showed fully as great a difference in the per cent of germination.

This must not be taken as an average test of the vitality of the seeds furnished by the above seedsmen, as in other varieties the results may be just the reverse.

It is noticeable that the varieties with a low vitality require a longer time for germination and are weaker and more uneven than those that give a high per cent of germination.

The quality of the seeds tested indicates that while the seedsmen as a rule send out seeds with a high per cent of germination, they frequently sell seeds that from age or otherwise are worse than worthless.

It is not fair to attribute any dishonest motives to the seedsmen whose seeds were below the normal per cent, and the only value perhaps to the public in the seed tests made by the different stations is to cause the seedsmen to take increased precautions to sell only seeds that are fresh and vigorous, and to show the purchasers the desirability of testing all seeds before planting, and thus saving much labor and perhaps the loss of a crop.

THE MIXING OF SEEDS.

Our seed tests lead us to believe that many if not all seedsmen practice the mixing of their old seeds with the new crop to an extent that cannot fail to be injurious to the purchaser. It was especially marked in the case of the cabbages, where some varieties germinated quickly and gave a high per cent of strong, stocky plants, while of other varieties perhaps 25 per cent sprouted in four days; two or three days after this 20 per cent more appeared, and still later another five per cent. The line between the different germinations was very marked and seems to indicate that some of the seed had been left over and had been mixed with new seed. With such mixtures the tester gave a considerable higher per cent than the seed boxes.

THE TESTS OF VEGETABLES AND FRUITS.

During the winter a large collection of seeds of the new and promising varieties of vegetables was obtained, and, with quite a number of standard sorts for comparison, they were planted at the proper time either in the forcing house or the garden.

In order to learn the value of the novelties in the different parts of the State fifty collections, containing from twelve to thirty varieties each, were made up and sent to persons who agreed to plant them carefully and report results in the fall.

The spring was quite unfavorable to a good stand of the plants, and the long continued cold wet spell in May and June, and the late frosts, were the cause of partial failure with such tender plants as the melons, squashes, cucumbers, corn and lima beans. The insects also were quite troublesome and the striped cucumber beetle and the black flea beetle did serious injury to several crops.

An attempt was made to complete as far as was possible the collections of fruits, both large and small. Among other additions were Russian and hardy seedling apples from the northwest, Russian and other pears, plums and cherries, with a long list of varieties of grapes, strawberries, raspberries and blackberries.

The trees planted in 1887 and 1888 are making a good growth and should bear a small crop next year. The available land for fruits belonging to this department is now all occupied, and at least ten acres should be set apart for next spring's planting.

SUB-STATION AT SOUTH HAVEN.

The soil and climate at Lansing are quite unlike those on the lake shore, the section where most of the fruit of the State is produced, and tests made here are not strictly reliable there.

In order that we may furnish the fruit growers of that section with opinions of the new varieties of fruits that they could depend upon, arrangements were made in the spring with T. T. Lyon, of South Haven, who has a large experimental plantation of the new fruits, to prepare a report on their behavior with him. This will be published in the early winter, and will, we feel sure, be of great value to the horticulturists of that section, and to a less degree, perhaps, of the State and nation.

THE APPLE ORCHARD.

The old apple orchard is thirty-two years old, and if traditions are correct has only borne one full crop, and that in 1887. For many years it was in sod, and, although the trees made a fair growth, little fruit was produced. The land slopes both from the east and west sides towards the middle of the orchard, and many of the tender varieties have been killed out, so that the center of the tract is quite open. The east half of the orchard, however, has lost but few trees.

In 1885 Prof. Bailey had the lower branches cut out so that a team could pass under the trees, the tops thinned when necessary, and the land broken up. It has been kept in cultivation without crops since that time. In 1887 one hundred and fifty trees gave nearly 3,000 bushels, and from present indications the crop will be nearly as large this year.

The trees were sprayed for the codling moth soon after the blossoms fell, using about three gallons to a tree of London purple mixed with water, at the rate of one pound to two hundred gallons.

It was applied by means of a field pump, using a "graduating spray" nozzle. This is the most satisfactory apparatus of any thus far tested. Several of our best varieties, such as Fameuse and Northern Spy, are often badly injured by the apple scab, a fungus that forms blotches on the fruit, often rendering it misshapen and unfit for market.

With the hope of finding some fungicide that would prevent it, five mixtures that are recommended by the Department of Agriculture were tried on two trees each. Three of them, solutions of sulphur, sulphuret of potassium and hyposulphite of sodium, seem to have but slight effect, but in the case of the trees sprayed with copper carbonate and ammonia, and "eau celeste" or blue water, the improvement is very marked. Frequent notes will be taken and the fruit when ripe will be assorted and weighed, and the exact effect of the treatment will thus be ascertained. The mixtures are coming into general use for the destruction of all kinds of fungi, and, with the Bordeaux, have given good satisfaction. They are prepared as follows:

1. *Copper carbonate and ammonia.* Mix three ounces of copper carbonate with one quart of ammonia 22° Baumé, and as soon as all action ceases dilute with 22 gallons of water.

2. *Modified eau celeste.* Dissolve 2 pounds of copper sulphate in hot water, and in another vessel dissolve 2½ pounds of carbonate of soda; mix, and before using add 1½ pints of ammonia and dilute to 22 gallons, with water.

3. *Bordeaux mixture.* Dissolve 6 pounds of copper sulphate in hot water. Slake 4 pounds of lime, mix and dilute with water to 22 gallons.

For the Bordeaux mixture various amounts of copper sulphate have been used, but for most fungi the above has proved effectual. This mixture is more destructive to the fungi than either of the others, but when the portion of the plant used as food is exposed the lime which is deposited is generally an injury to it. In the case of the potato blight and similar fungi, it is preferable to any other mixture.

During the year the department has received a large number of fruits and vegetables for trial. They will be acknowledged in the report of results.

In order that the Station may be of the most value to the farmers of the State it is desirable that all new fruits and vegetables should be sent here for trial before they are placed on the market.

For a thorough test three trees, such as the apple, pear and plum, six raspberry plants and twenty-five strawberry plants should be sent, while from one to two hundred seeds of vegetables will be necessary.

If it is desired the plants will be grown under number, but if the variety has been named the names will be required as an evidence of good faith before any report will be furnished.

L. R. TAFT,
Horticulturist.

MICH. AGR'L COLLEGE,
June 30, 1889.

REPORT OF THE CHEMIST OF THE EXPERIMENT STATION FOR 1888-89.

Hon. Oscar Clute, Director of the Experiment Station:

SIR—In presenting my annual report as Chemist of the Experiment Station, the work performed and the results reached will be set forth under the following heads:

I.—THE EXPERIMENTAL FARM AT GRAYLING.

This farm of 80 acres in Crawford county is in the heart of what is called the Pine Barrens, and is a fair representative of the light, sandy soils of the State where the principal forest growth is jack pine (*Pinus Banksiana*) and popularly known as Jack Pine Plains. Along with the jack pine there are found scattering trees of Norway pine, shrubs of scarlet oak, red maple, dwarf huckleberry and sand cherry, sweet fern, brakes, and many kinds of bunch grass. The soil is a yellow to brown sand, having little cohesion and small retentive power. Chemical analysis shows the presence of 94 per cent of sand and insoluble silicates, and only 2 per cent of organic matter. The repeated fires that have swept over these plains explain the deficiency in organic matter in these soils, and afford a reason for the kind of forest growth most common on these plains.

When the land is plowed, after clearing off the trees and shrubs, the soil is usually found too open and porous to sustain crops; the rain sinks too rapidly, the capillary power of the soil to bring up moisture from beneath is too feeble, and the root contact with the soil by the plant too imperfect to secure satisfactory growth.

The two conditions to be secured at the very outset after "breaking the ground," is to increase the amount of vegetable matter in the soil, and to secure a good seed bed by compacting the loose sand. For these purposes three measures have been adopted: (1) To keep out the fires that burn up the annual accumulation on the ground of leaves and vegetable materials and even destroy a part of the organic matter in the soil; (2) to raise on the ground plants that will afford the largest amount of organic matter, to be plowed under as green manure, and thus rapidly increase the organic matter in the soil, and available material for the growth of succeeding crops; (3) the free and repeated use of the harrow and roller to compact the soil.

The changes that have been effected in two seasons' growth by these agencies are evident to any one who will examine these experimental fields. The darker color of the soil, its greater firmness and the increased growth of crops all bear witness to a favorable change.

Fertilizers Used.

The investigation of the capabilities of this soil was conducted entirely on the basis of practical utility—to answer the question whether a man with limited means, and unable to buy costly fertilizers, could hope to make a satisfactory farm on the plains. The use of barn-yard manures was rejected for two good reasons: Because it had been already fully demonstrated that large crops could be grown on the sands with a free use of barn-yard manure, and in the second place the supply of such manure was too limited for the vast area to be occupied. For similar reasons commercial fertilizers were not used in these experiments. It would be easy by the free use of any or all these materials to obtain surprising crops, and astonish the public with a display of crops from the barren sands, but for the settlement of the real problem of the sands, such displays would be as useless as they are surprising.

In like manner, by selecting some unusual soil for experimenting—a beaver meadow or river bottom, where the accumulation of plant food and the supply of soil moisture were exceptional—the crops would outstrip all that could be shown on the characteristic sands of the pine barrens.

Such results and displays are very good for the county fair and the office of the local newspaper, "to show what our county can produce," but they are very far from solving the real problem of the plains. For this purpose a fairly representative soil must be chosen, the conditions of climate and exposure such as prevail in the region, and the fertilizers such as are within the means of farmers of limited means who would make their homes on these cheap lands.

For these reasons three manurial substances have been selected for these experiments, viz., marl, plaster and salt. These are all very cheap materials. The marl, or bog lime, a mixture of carbonates of lime and magnesia with a varying amount of sand and clay, and usually containing a small amount of phosphate of lime, is found in such quantities in the small lakes and bogs of this region that the expense of getting out and onto the land is practically all the expense of using it, the first cost of the material in its bed being nothing. As found in the lakes, the soft quality of the marl and its tendency, when disturbed, to run into a slimy mass, makes the effort to shovel it out difficult. The tendency to assume a semi-fluid character when stirred in water, might be taken advantage of to pump it up into a trough or pipe and let it run off to a platform on dry land, where the excess of water would flow or drain away and leave the marl in good condition for hauling in a few weeks or months at the most. A belt with attached buckets, such as used for elevating wheat, might be mounted on a scow, the lower end of the bucket pump being sunk into the marl bed and capable of being moved about into a fresh position as the marl is exhausted by pumping, the buckets discharging into a hopper to carry the semi-fluid marl by a trough to bed with porous sand for a bottom, through which the water may drain away—some such arrangement to be worked by horse-power, or by hand, might carry the marl to accessible points. If left all winter to freeze and dry it would be in good condition for use in the spring. It is hoped to rig and put to use such marl pump at Grayling in the near future.

These three materials, marl, plaster and salt, are the only manures used on this experimental farm. The marl when used in doses of five tons to the acre has shown marked benefit to all the crops to which it has been applied. The clover as a class, spurry, lupines, tall fescue and perennial rye grass, were especially benefited by the marl. A spot of ground on which the marl had been deposited in a body before it was scattered over the rest of the field made a very bright spot of green, visible at some distance, by reason of the increased growth of tall fescue and perennial rye grass sown thereon. There is little danger of using marl too freely on these sandy soils.

Plaster showed much benefit, especially on the leguminous crops, and paid well for its use. It was used freely, 200 pounds to the acre. In beneficial influence it stood next to marl.

Salt seemed to be of no benefit to any of the crops except buckwheat. In many crops it seemed to be a damage, especially to clovers and millet. It was used at the rate of 200 pounds to the acre. The land does not seem to be in condition to be benefited by salt at present. Possibly the small amount of organic matter would hinder the beneficial action of salt.

The Crops Sown.

It was a matter of first importance to find what crop would grow on these sands and yield the largest amount of organic matter to replenish the hungry soil. A variety of seeds were sown, not with the expectation that all would be equally useful or successful, but the knowledge that certain plants are failures under the conditions on the plains is of some value. The plants usually recognized as valuable, either for forage or for green manures, have received first attention.

Plants that under other climatic conditions might be of great value, may be useless in these northern counties by reason of frost or drouth, or both combined.

The following plants have practically been failures on the experimental farm, mainly on account of frost: Cow pea, New Zealand spinach, yellow branching sorghum, martynia, borage and rape.

The cow pea would be of great value if not so easily cut by frost. Much had been expected from white mustard, which has proved so useful on light sands in Europe, but it was of little value here.

The plants moderately successful were blue and yellow lupines, Kentucky blue grass, seven-leaved turnip, timothy (sowed alone) and meadow foxtail. The blue and yellow lupines took a very strong hold on the soil and made a strong growth if the frost was not too severe. The energy with which the lupines attack the soil has give the plant its name (Lupus, a wolf). But the blue and yellow lupines do not seem to withstand the frost as well as the more hardy white lupine. Timothy sowed by itself, and for a first crop, made very moderate growth, but when sowed as a second crop with June clover, it made a very satisfactory meadow sward. Blue grass made almost no catch, perhaps from poor seed. The seven-leaved turnip did not make as good top growth as the white turnip, leaving out of account the tubers of the latter.

The following plants have been a success on the Experimental Farm: Spurry, mammoth clover, June clover, alfalfa, white clover, vetch, field peas, Hungarian grass, millet, buckwheat, rye, Bokhara clover, perennial rye grass, tall fescue and white turnips.

The spurry has shown wonderful productiveness and seed production. When partially ripened and plowed under with a very shallow furrow it is self-seeding and produces an abundant crop. Its value as a manurial plant on these light sands is pronounced. When plowed under it seems to enrich the soil the most rapidly of all plants used. It is valuable for a fodder plant, being readily eaten by cows and sheep. It is said to be very valuable for cows giving milk. It is a plant of first value in bringing these sands into productive fields.

Both the red clovers have done very satisfactorily. Their deeply penetrating roots enable them to resist drought and their ability to withstand frost make them valuable plants for the plains. Their value both as fodder and for manure are so well known that no words are needed on these points. The plants make a vigorous growth as individual plants, but do not cover the ground with an even sward, but they improve when following other crops. The flea-beetle has proved destructive to these clovers when they first come up. The cut-worms were very destructive last May on the well-grown plants.

The alfalfa made a very good growth and its strong roots penetrated the soil to great depth; a plant of good promise on the sands.

White clover made a good sward and promises well.

Rye made a poor growth the first year on newly-broken soil; the second year after a crop of millet plowed under, it made a good growth, "shoulder high," which was plowed under when ripe, and a new crop of great promise is now growing.

Buckwheat made a fair growth the first year, but after a crop of spurry the buckwheat was "just immense," to quote the words of an intelligent examiner.

The Hungarian grass and millet made a good growth on lands just broken, and the second year made a very satisfactory crop, heavy growth and well filled with seed.

Field peas made a good growth and a satisfactory crop, which, instead of being harvested, was plowed under, and a very vigorous second growth is now coming forward. Peas promise good results as a manurial crop.

White turnips made a good growth and produced a fair crop of tubers on the first breaking of the soil.

A crop of spurry after the turnips made a very fine strong growth.

The perennial rye grass and tall fescue give great promise as meadow grasses. They seem to more completely form a sward than any of the grasses or forage plants tried.

Influence of a Manurial Crop.

It is difficult to point out on each crop the effect of a green crop plowed under the preceding year; yet the influence was marked in all the crops. A very intelligent and close observer who has watched this experiment month by month from the very beginning, estimates that the increase by reason of the manurial crop is at least seventy-five per cent on the average of all, and one hundred per cent in some of the crops.

Many persons offer suggestions of ways to solve this problem of the sands, and such suggestions are always welcomed, even if not adopted. The end proposed by the Chemist is to follow lines of investigation which will be open to all, and not involve very large expenditure. It is well known that the deficient supply of moisture in the soil during the growing season is a serious difficulty in cultivating these sands. One writer suggests a plan of irrigation by using the rivers of this region for that purpose. But when we consider the large use of these streams for lumbering enterprises, the expense involved in irrigating works on the large scale, and that only a part of these plains could thus be irrigated, this plan does not seem feasible at the present time.

As in most undertakings where time is required for working out results so as to reach reliable data, many persons are crying out for quicker results, and intimating that time is squandered and money wasted without benefit to the public. While all would be delighted to arrive at the true solution of these questions with all celerity, thoughtful persons will concede that little is to be gained by impatient haste for immediate results.

If these lands can be brought to such a condition of productiveness that they can be converted into stock-feeding farms, where only wool, meat and dairy products are sold off the land, and all the rest of the produce is returned to the soil to further increase its productiveness, the problem of the sands will be in a fair way for solution.

II. RELATION OF CULTIVATION TO SOIL MOISTURE.

The influence of the condition of the surface soil on the content of moisture in the soil has attracted the attention of thoughtful observers. Some investigation has been made on this subject, both at the experimental farm at Grayling and at the College. Specimens of soil were carefully examined for the per cent of moisture they contained at different periods during the growing season from May to October, 1889. Five plats of ground at each station were selected of uniform character and in close proximity. The soil at the College was sandy loam; at Grayling, sand. One plat was cultivated repeatedly during the season, viz: at each time of gathering the specimen for analysis. A common one-horse cultivator was used. A second plat was raked over with a garden rake at each time of collecting the specimens. A third plat was left without treatment, or in naked fallow with nothing growing on it. A fourth plat was in meadow (timothy sod), but raked with an iron rake at each time of gathering specimens. The fifth plat was timothy meadow, with no treatment. Two sets of specimens were gathered each time, a surface soil, taking the upper eight inches in each case, and an under soil, taking the soil between eight and sixteen inches from the surface. The soil was at once placed in quart fruit jars, closed air tight, packed in boxes with sawdust to screen them from any possible drying influence, and taken to the laboratory for analysis. The soil from both stations was treated substantially in the same way, but the soil from Grayling had to be sent 170 miles by railway.

It was designed to have the soils gathered at the same dates, but the correspondence of time failed to be realized. The following tables give the results:

TABLE 1.—*Percentage of Moisture in Soils Collected at Agricultural College, 1889.*

Date of Collecting.	Plowed Land.						Grass Lands.			
	Cultivated.		Raked.		Unworked.		Raked.		Unworked.	
	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.
May 25	16.25	15.10	17.85	9.52	13.50	12.20	7.44	2.72	8.06	3.50
July 8	14.50	11.83	11.36	8.28	10.86	11.03	--------	--------	6.52	6.77
" 25	16.15	12.15	13.91	9.08	12.07	11.93	7.63	3.70	8.20	4.35
August 1	14.07	12.22	12.25	7.03	12.80	10.70	8.00	5.75	9.07	5.18
" 12	14.73	9.44	13.07	6.95	12.34	9.92	3.17	2.43	3.75	2.36
" 19	14.23	13.50	13.20	8.70	11.22	11.82	3.44	2.63	3.32	2.62
" 25	12.55	12.34	10.52	3.05	11.30	10.80	2.30	1 90	2.76	2.54
September 2	13.40	8.70	10.00	5.22	6.60	6.60	2.21	2.00	2.15	2.04
" 11	11.33	8.29	7.93	5.18	9.83	7.58	2.85	1.83	2.49	1.87
" 27	10.44	7.40	9.81	4.18	8.73	6.51	3.00	2.18	2.90	1.75
October 4	10.90	8.80	7.50	6.05	4.70	4.06	3.87	2.43	2.95	2.30
" 11	9.55	8.20	5.94	4.50	5 60	4.50	2.84	2.14	2.52	1.83
" 18	12.50	5.52	8.15	5.90	9.00	6.80	2.92	2.20	2.45	2.05
Means	13.89	10.27	10.88	6.44	9.89	8.73	4.14	2.66	4.09	3.01

TABLE 2.—*Percentage of Moisture in Soils Collected at Grayling, 1889.*

Date of Collecting.	Plowed Land.						Grass Land.			
	Cultivated.		Raked.		Unworked.		Raked.		Unworked.	
	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.	1st 8 Inches.	2d 8 Inches.
May	5.67	5.14	5.70	4.69	6.81	5.00	5.98	5.68	6.06	5.15
July	5.18	4.09	5.40	4.00	4.02	4.38	2.04	2.71	2.00	--------
August	4.61	5.61	6.57	4.76	5.64	3.72	4.90	3.91	4.81	4.83
October 1	6.87	5.75	8.12	5.45	7.08	4.90	7.58	5.46	7.56	6.05
Means	5.58	5.15	6.45	4.72	5.89	4.50	5.12	4.44	5.11	5.34

These tables present some interesting results, but in order to see their exact bearing, the rainfall for the season must be considered.

	Rainfall at College, Inches.	Rainfall at Grayling, Inches.
1889. May	3.61	2.85
June	3 42	4.05
July	3.41	3.55
August	.68	1.95
September	.79	.70
October	.65	.72

From the 1st of August to the 31st of October there were 2.12 inches of rainfall at the College, yet the average percentage of water in the cultivated surface soil was 13.89, just 3 per cent more than similar soil left as naked fallow. From September 27 to October 18, without a drop of rainfall, this cultivated soil increased 2 per cent in moisture without any corresponding change in the layer of soil immediately below it. The raked surface soil had 1 per cent more water than the naked fallow, but 2 per cent less than the cultivated soil.

In the sands at Grayling the benefit from cultivating does not appear, and only slight benefit from raking. The smaller percentage of water in the grass lands in both stations is marked. These might be expected from the large amount of evaporating surface of the grass plants and the demand for moisture from the soil. The raking of the grass was done to see if harrowing or scratching the surface would tend to keep meadows moist the same as plow-land. No influence of this kind is apparent.

These experiments on soil moisture as modified by the physical condition of the soil will be repeated and extended another year, and an effort will be made to ascertain the influence of rolling and compacting the surface soil.

III.—SOIL TEMPERATURE.

Observations on the temperature of the soil at various depths during the growing season have been made at the College and at Grayling. The soil thermometers were made by Green, of New York, and the temperature was observed thrice daily, at 3, 6, 9, 12 and 24 inches below the surface. The record is given in the following tables, from the 1st of April to the 31st of October for both localities.

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, APRIL, 1889.

Date.	7 A. M.					1 P. M.					7 P. M.				
Depth in inches	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
April 1	33½	34	34	35	35½	42	38½	37	35½	36½	39	38½	38	37½	36½
" 2	37	37	37½	37½	37	43½	40	38	37½	37	41	40½	39½	38½	37
" 3	39½	39½	39½	39	37½	39	39½	39	39	38	39	40	39	39	38
" 4	35½	36½	37½	38	38	42½	39½	38	38	38	40	40½	40	38½	38
" 5	35	36½	37½	38	38	42	39½	37½	37½	38	37½	38½	38½	38	37½
" 6	33½	35	36½	37	37½	46	40½	37	37	38	------	------	------	39	38½
" 7	37	37	38½	39	38½	50½	45	40½	39	38½	48	47	44	41½	38½
" 8	40½	41	41½	41½	39½	46	43½	42	41½	40	46½	46	44	42½	40
" 9	44	44	44	43	40½	51½	47½	44½	43½	41	51	50	47	45	41
" 10	43	44	45	45	42	57	51	46½	45	42½	50½	51	50	47½	43
" 11	46½	47	47½	47	43½	49½	48	47	46½	44	49½	49	47½	46½	43½
" 12	46½	47	47	46½	44	46	46½	46½	46½	44	------	------	------	------	------
" 13	38	40	42½	43½	44	53	48	45	43½	43½	48	48½	47	45½	43½
" 14	39	40½	43	44	44	53½	49	45	44	43½	49½	49½	48	45½	43½
" 15	40	42½	44½	45	44	55½	50	46	45	44½	51½	51½	49	46½	44
" 16	43	44	46	46½	45	60½	54	49	46	45	54½	54½	52	49	45
" 17	44½	46½	48	48	45½	62	55½	50	48	46	58	57	54	50	46
" 18	50	51	51	50½	47	63½	58	52½	50½	47	59	58½	56	52	47½
" 19	56	55	53	53	48½	59	57	55	53	48½	------	------	------	------	------
" 20	52	52	53	53	49	65	59	54½	52½	49½	60	60½	58½	55	49½
" 21	53	53	54	54	50½	64	59½	55½	53½	51	59	60	58	55	51
" 22	48	49	52	52½	51	61	56½	53	52	51	58	58½	56½	54	50½
" 23	48	49½	51½	52½	51	60	56½	53	52	51	56½	56	55½	53½	50½
" 24	52	53	53½	53	51	62	57½	54½	53	51	53½	55½	55½	54½	52
" 25	48½	50	51½	52½	51	49	49	50	51½	51	48	49	50	51½	50½
" 26	46	47	48	49	49½	56	51	49	49½	49½	57	55	53	50½	49
" 27	47½	49	50	50½	49½	51	50	50	50	49½	50½	51	50½	50	49½
" 28	48	48½	49	49½	49	53	51	50	49½	49	50	51	50½	50	49
" 29	45	46½	48½	49	49	47	47	47½	48	49	46	47	47½	48	48½
" 30	42½	41½	46	47	48	47½	46½	46	46½	48	46½	47	47	47	47½
Means	43.7	44.7	45.7	46.0	44.9	52.6	49.1	46.6	45.8	44.8	49.9	50.0	48.7	46.8	44.6

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE MAY, 1889.

Date.	7 A. M.					1 P. M.					7 P. M.				
Depth in Inches..	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
May 1.....	41	42	44½	46	47½	54	50½	47½	46	47	49	49	49½	48	47
" 2.....	44½	46	47	47½	47	48	47	47	47	47	47	47½	47½	47	47
" 3.....	42	43	45	46	47	62	54½	48½	46½	47	56	54	56	50½	47
" 4.....	48½	49½	50	50	48	64	57	52	50	48½	59	56	59	52½	48½
" 5.....	52½	52	52½	52½	49½	67	60	55	52½	49½	62½	58½	61	55	49½
" 6.....	55½	55½	55½	55	51	68	62	57	55	51½	67	61	65	57	51½
" 7.....	59½	59	58½	57½	52¾	73	66	60½	58	53	64½	64½	68	60	53
" 8.....	63½	62½	62	60½	54½	76	69	63½	60½	55	71	63½	67	60½	55½
" 9.....	65½	64	63	62½	56½	75½	69	65	62	57	72	67	70	63½	57
" 10.....	65	65	64½	63	57½	75	69	65	63	58	73	68	72	64½	58
" 11.....	63	64	64½	63½	58½	80	71½	66	63½	59	73	69	72½	65½	59
" 12.....	61½	62	64	63½	59½	78½	70	65	63	59½	72	68	71	65	59½
" 13.....	60½	62½	63½	63½	60	63	62	62½	62½	60	62	62	62	61½	59½
" 14.....	57½	59	60	60½	59	75	66	61	60	59	71	65	69	62	58½
" 15.....	58½	60	61½	61½	59	62	61	61	60½	59	60½	60½	61	60	58½
" 16.....	57½	58½	59½	59½	58	58	58	58	59	58	62	60	61½	59½	58
" 17.....	61	60½	60	59	57½	73½	68½	63	60	57½	70½	66	69	62½	58
" 18.....	65	64½	64	63	59	80	73½	67	63½	59	74½	69½	73	65½	59½
" 19.....	63	64	65	63½	60½	69	66½	65	63½	60½	65	66	66	64	60½
" 20.....	59	60	61½	62	60½	72½	67½	64	62	60	64	66	66	64	60
" 21.....	54½	57	59½	61	60	54½	56	58	59	59½	53½	57	55½	58½	59
" 22.....	49½	51	53½	56	58	54	53	53½	55	57	54	55	55	55½	56½
" 23.....	48	50	52	54	56	52½	52½	53	54	57	53½	54	53½	56½	56½
" 24.....	52	52½	53½	54½	55½	69	63	58	55½	55½	62	60½	62	58	55
" 25.....	51	53½	56	57	56	62½	59½	57	56½	56	58½	58½	59	57½	55½
" 26.....	50½	53	55	56	56	68	62	57½	56	56	62½	60½	62	58	55½
" 27.....	55	56	57	57½	56	55	56½	56½	57	56	54	56	55	56½	56
" 28.....	45	49	52	54	55½	63	58	54	53½	55	57½	57½	58	56	54
" 29.....	49½	52	54	55	55	50	51½	53	54	55	48½	52½	50	53	54½
" 30.....	44½	46½	49	51	53½	45	46½	48	50	53	44½	47½	46	49½	52½
" 31.....	44½	45	46½	48	51½	48	47	47½	48	51	48½	48½	48½	49	50½
Means.....	54.5	55.4	56.6	56.9	55.3	64.4	60.4	57.7	56.6	55.4	61.0	59.6	61.0	57.9	55.5

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, JUNE, 1889.

DATE.	7 A. M.					1 P. M.					7 P. M.				
Depth in Inches..	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
June 1....	47	47½	48½	49	50½	49½	49	49	49	50½	47½	49	49½	49½	50½
“ 2....	47	48	48½	49	50½	48½	48½	49	49½	50	49	49	49	49½	50
“ 3....	48	48	48½	49	50	52½	51	49½	49½	50	51	51	51	50	50
“ 4....	48½	49	50	50	50	55½	53	51	50½	50½	52½	53	52	51½	50½
“ 5....	50½	51	51½	51½	50½	66	59	54	52	51	56	57	56½	55	51½
“ 6....	51	52½	53½	54	52	69	61½	56½	54½	52½	63	62½	60	57½	52½
“ 7....	58	58	58	57	54	60½	59½	58	57	54	60	59½	58	57	54½
“ 8....	60	59	58½	57½	55	58½	59	58½	58	55	57½	58	58	57½	55
“ 9....	55	55½	56	56½	55	64	60	57	56½	55	61½	61	59½	58	55
“ 10....	55	57	57½	57	55	56½	57	57	57	55½	56	56½	57	56½	55
“ 11....	54	55	55½	56	55½	66½	62	58	56	55	61½	61½	60	58½	55
“ 12....	56½	57	58	58	55½	70½	64½	60	58	56	66	65	63	60½	56½
“ 13....	60	60	60	60	57	73	67	62½	60	57½	68½	67½	65½	62½	57½
“ 14....	62	62	63	62	58½	73½	59	65	62½	59	70	69	67	61	59
“ 15....	65½	65	65	64	60	72½	69	66	64	60	70	69	67½	65	60
“ 16....	65	65	65	64½	61	69	67	65	64	61	68	67	66	64½	61
“ 17....	65	65	65	64½	61½	70	68	66	64½	61½	68	68½	67	65	61½
“ 18....	63	63½	64	64	61½	71½	69	65	64	61½	69½	69½	68	65½	61¾
“ 19....	67½	67	66½	65	62	77	72	68	66	62½	72½	72	70	68	62½
“ 20....	64½	65½	67½	66½	63½	73½	71	68	66	63½	70	70	69	67½	63½
“ 21....	66½	66½	67	66½	63¾	67½	67	66½	66	64	65½	66	66½	66	63½
“ 22....	61	62	63	64	63	63½	63	63	63	63	62	62½	63	62½	62½
“ 23....	57½	58	59½	61	62	68½	64½	62	61	61½	65	65	63½	62½	61
“ 24....	58	59	61	61½	61½	66½	63½	61½	61½	61	64	64	63½	62½	61
“ 25....	50	60	61	61½	61	71	66½	63	62	61	69	68	66	64	61
“ 26....	63	63½	64	64	61½	72½	69	65½	64	62	70	69	67½	65½	62
“ 27....	65	65	65½	65	62½	77½	72	67½	65½	63	71½	71	70	68	63
“ 28....	67	67	68	67	63½	79	72½	69	64	64	75	74	71½	69	64
“ 29....	68	68½	68½	68½	65	80	74½	70½	68½	65	74½	74	72½	72½	65
“ 30....	70½	70	70	69½	66	78½	73½	71	69	66	75	74	72½	72½	66
Means.....	59.0	59.7	60.2	60.1	58.3	67.4	64.1	61.4	60.1	58.4	64.3	64.1	63.0	61.4	58.4

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, JULY, 1889.

Date.	7 A, M.					1 P. M.					7 P. M.				
Depth in inches ..	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
July 1....	68½	69	70	69½	66½	84	72	72	70	67	78½	77½	75	72	67
" 2....	71	71½	72	71½	67½	85½	79	74	71½	67½	79½	78½	76½	73½	68
" 3....	73	73½	73½	72½	68½	76	74½	73	72	68½	72½	73	73	72	68½
" 4....	65	66	68	69	68	74½	74	70½	69	67½	72	73	72	70½	67
" 5....	65	67½	68½	69	67½	78	73½	70½	69	67½	74	74	72½	70½	67
" 6....	67	68	69	69¼	67½	81	75	70½	69½	67½	76	76	74	71½	67½
" 7....	70	70	70½	70½	68	82	77	73½	70½	68	77½	77	75	72	68
" 8....	70½	71	71½	71½	68½	82½	77	73	71½	68½	79	78	75½	73	68½
" 9....	72	72½	73	72	69	84½	78	74½	72½	69½	80½	79	77	74	69
" 10....	73	73½	74	73½	70	81	78	74	72½	70½	------	------	------	------	------
" 11....	69	71	72½	72½	70	88	79	74½	72½	70	80	80	77½	74½	70
" 12....	69½	71½	73	73	70	85½	78	74	72¼	70	81	80	77	74	70
" 13....	73	74	74	73½	70¼	89	80	75½	73½	70½	81½	80½	78	75	70
" 14....	71	72	73½	73½	70½	69	70½	72	72½	70½	66	68	70	71	70
" 15....	64½	65½	67	68½	69	78½	73½	70½	68½	69	74	74	73½	71	68½
" 16....	65	67	69	70	68½	81	75½	71½	70	69	76	76	75	72	68½
" 17....	67	69	71	71	69	76	73½	71½	70	69	75½	75	73½	71½	69
" 18....	68	70	71	71	69	73½	72	71	70½	69	73½	74	73	71½	69
" 19....	71½	71½	71½	71½	69	77	74½	73	71½	69	75½	75	74	72½	69
" 20....	69	70	70½	71	69	72	70½	70	70	69	71½	71	71	70½	68½
" 21....	66½	67	68	69	68½	76½	73	70	69	68½	74	73½	72½	70½	68
" 22....	67	68½	69½	70	68½	81	76	72½	70½	69	76	76½	75	73	69
" 23....	67	69	71	71	69	77½	74	72	71	69½	75	75	74	72½	69
" 24....	66	68	70	70½	69	82½	75½	70¼	70	69	75½	76	75	72½	69
" 25....	65½	68	70	70½	69	84	76½	72	70	69	76½	77	75½	73	69
" 26....	69½	70	71½	72	69½	72½	71½	71½	71	69	73½	73	72	71	69
" 27....	68½	69	70½	70½	69	81½	76	72½	70½	69	79	77½	75½	72½	69
" 28....	67½	68	69	70	69	78	74	71½	70	69	74½	74½	73½	72	69
" 29....	67	68½	70	71	69	68	68½	69	69½	69	68½	69	69	68½	68½
" 30....	64½	66	67½	68	68	77½	72½	69½	68½	68	72½	72½	72	70½	68
" 31....	64½	66	68	69	68	80	74	70½	68½	68	75	75	74	71½	68
Means	68.3	69.4	70.6	70.8	68.8	79.3	74.7	72.0	70.7	68.8	75.5	75.3	74.0	72.0	68.6

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, AUGUST, 1889.

Date.	7 A. M.					1 P. M.					7 P. M.				
Depth in Inches..	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
August 1..	66½	68	69½	70	68½	75	72½	70½	69½	68½	73	73	72½	71	68½
" 2..	68½	69	70	70	68½	76	73	71	70	68½	73½	74	73	71½	68½
" 3..	68	69	69½	70	68½	79	74	71¼	69¾	68½	75	75	74	71½	68
" 4..	66½	67	69	69½	68½	83½	76¼	71½	70	68½	78	77	75	72	68½
" 5..	68	70	70½	71	69	78½	73	71	70½	69	76	75	74	71½	68½
" 6..	64½	67½	69½	70½	69	81½	74½	71	70	69	78	77½	74½	72	68½
" 7..	67	68½	70½	71	69	80½	74	71	70½	69	78½	77	74½	72	68¾
" 8..	69	70	71	71½	69	74	72	71	70½	69	72½	72½	72	71	69
" 9..	69½	70	70	70	68½	71	70	70	70	68½	69	71	70	70	68½
" 10..	63	65	68	69	68	77½	73	69½	68½	68	71	72	71	70	67½
" 11..	61	63½	67	68½	68	83½	75½	70	68½	68	73	74	73	71	67½
" 12..	63	66	68½	69½	68	80	73½	70	69½	68½	78	77	74	71	68
" 13..	69½	70	71	71	68¼	75	72½	70¾	70	68¼	70½	72	71½	70½	68
" 14..	68	68	69¼	70	68¼	69½	68½	69	69½	68	68	68½	69	69	68
" 15..	62½	64	66	67½	67½	75	71	68	67½	67½	67	67	68½	69	67
" 16..	62½	64½	67	68	67	73	69½	67½	67	67	71½	71½	70	68	66½
" 17..	61½	63½	66	67½	66¾	76½	71	67½	67	67	71	72	71	69	67
" 18..	63½	65¼	67¼	68	66½	75	70½	68	67½	67	73	71¼	70¾	68¾	66¾
" 19..	67	68	69	68¾	66¾	80	74	71	68½	67	75	74½	73	70½	67
" 20..	70	70½	71	70½	67¼	78	73½	71¼	70	67½	76½	75	73	71	67½
" 21..	71¼	71¾	71¾	71	67¾	77½	74	72	70¾	68	73½	74	73	71¼	68
" 22..	65½	67½	69½	70	68	80½	73½	70½	69½	68¼	75½	75	72½	70½	68
" 23..	65	67½	69½	70	68	78½	73¼	70½	69½	68½	77	74¾	72	70	68
" 24..	66¼	68¼	69¾	70¼	68	77½	72	70	69½	68½	75½	74½	72	70¼	68
" 25..	66½	68	69½	69¾	68	80½	74	71	70	68½	78	76	73	70¼	68
" 26..	69	69½	70½	70½	68½	78½	74½	71	70½	68½	77	75	73	71	68¼
" 27..	69	70½	71½	71½	68½	83½	78	73	71	68¾	80	78	74½	71½	68½
" 28..	68½	70½	72	72	69	81½	74½	72	71½	69	79	78	74½	72	69
" 29	68½	70½	72	72	69	83	75	72½	72½	69½	78	77½	75	72½	69
" 30..	70½	72	73	72½	69	83	76	73	72½	69½	81	79	75½	73	69½
" 31..	71	72	73	73	69½	82	75½	73¼	72½	70	79	78	75	73	70
Means	66.8	68.2	69.7	70.1	68.2	75.8	73.3	70.6	69.8	68.4	74.9	74.6	72.7	70.8	68.1

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, SEPTEMBER, 1889.

Date.	7 A. M.					1 P. M.					7 P. M.				
Depth in inches	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
Sept. 1	70	71	72½	72½	70	85½	77	73	72	70	80½	78½	75	72½	69½
" 2	71½	72½	73	73	70	79	75	73	72½	70	78	77	74½	73	70
" 3	72½	73	73½	73	70	76	74	73	72½	70	75	75	73	73	70
" 4	72	72½	73	72½	70	77	74	72½	72	70	77	75½	74½	72½	70
" 5	70	72	73	72½	70	70	70½	71½	72	70	66	67½	69½	71	70
" 6	60½	63	65½	68½	69½	70½	68	67	67½	69	67½	68½	69	69	68½
" 7	60½	62½	65	67½	68	73	69	67	67	68½	68½	70	70	69	68
" 8	63	64	66	68	68	76½	71½	68½	68	68	74½	73	71½	69	67½
" 9	64½	66	68	69	67½	72½	69	68¼	68¼	68	71½	71½	71	69½	67¾
" 10	67½	68	69	69½	68	78	73	69¾	68½	68	74	74	73	71	67¾
" 11	68	69½	70	70½	68	81	74	71	70½	68½	77½	76	74	71½	68¼
" 12	67	70	71	71	68½	79	73½	71	71	69	72½	74	73½	71½	68¾
" 13	66½	69½	70½	70½	68½	70½	69½	69½	70	69	70½	71	70	69½	68
" 14	68	69	69½	69½	68½	73	74	70	69½	68½	76	75	72	70	68
" 15	69½	70	71	70½	68	74	73	70¾	70½	68½	70	71	71½	70½	68½
" 16	58½	62	66½	68½	68	62¾	63	65	67	68	61½	63	65	67	68
" 17	53	56½	62	65	67	62	60½	62	64	66½	56½	59½	63½	64	66¼
" 18	51½	54½	60	62½	65	55½	57½	59½	62	65	56½	59	60	62	65
" 19	52	56	58½	61	64	62	58	58½	60½	64	61½	61½	61	61	63½
" 20	57½	59½	60½	61½	63½	59	59½	60	61½	63	55	57	59	60½	62
" 21	49	52½	57	60½	62½	54½	55	58½	59	62½	55½	56½	57	59	62
" 22	46	52	55	58	61½	61½	55	54¾	57¼	61½	60½	60	58½	58½	61
" 23	54	55½	57	58½	61	62½	58½	58	59	61	63	61½	60	59½	60½
" 24	56	59	60	60½	61	69½	61½	60	60½	61½	67½	66	63½	61½	61
" 25	64	64	64	63	61½	62	63	63½	63	61¾	67½	61	63	62	61
" 26	49½	56½	58½	61	61½	51½	55	57	60	61¾	51½	55½	57	69	61½
" 27	45	51½	54	57½	60½	54	54	57	57	60½	53	55	55	56½	60
" 28	48½	52½	54½	56½	59½	71	59	55	56½	59½	62½	62	59	57½	59
" 29	57	54½	57	58½	59½	59½	58	57	58	59¼	59	59	58	58	59¼
" 30	55½	56	57½	58½	59	57	57½	57¾	58½	59	57	57½	58	58½	59
Means	60.3	62.5	64.4	65.6	65.6	68.0	65.3	64.6	65.2	65.7	66.2	66.4	66.0	65.9	65.3

RECORD OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE, OCTOBER, 1889.

Date.	7 A. M.					1 P. M.					7 P. M.				
Depth in Inches	3	6	9	12	24	3	6	9	12	24	3	6	9	12	24
Oct. 1	55	56	57½	58½	59	57	57	57½	58	59	54	55	57½	58¼	59
" 2	50	51	55	57½	59	62½	58	55	57	59	58	59	58	57½	58½
" 3	54	55	57	58	58½	68½	63	57½	58	59	59½	60½	60	59	58½
" 4	50	53	57	58½	58½	59	56½	56½	58	59	56	57	57½	58	59
" 5	53	54	56	57½	58½	56½	56	56	57	58½	54	55½	56½	57	58½
" 6	47	49½	53¾	56	58	49	50	53	55½	58	48¾	50	53	55	57½
" 7	43	45½	50½	54	57	56	51½	50½	53½	57	50	51½	52½	53½	56½
" 8	39½	43	49½	53	56	52½	50½	49½	52½	56	50½	51½	52	52½	55¾
" 9	45	47½	50	52½	55½	54	52	50½	52½	55½	52½	53½	53	53	55
" 10	45½	48½	52	53½	55	54½	52	51½	53	55½	55	55	54½	53½	55
" 11	52	52½	53½	54	55	55	52½	52	54½	55½	58½	57½	55½	55	55
" 12	53	54½	55	55½	55½	54	54½	54½	55	55½	55	55	54½	55	55½
" 13	49½	52	53½	54½	55½	52½	52½	53	54½	55½	52	53½	54	54½	55½
" 14	46	49½	52	53½	55	50½	49½	51½	53	55	52½	52	52	53	55
" 15	44½	48	51	53½	54½	50½	49½	50	52	55	53½	53	51½	52	54½
" 16	46	49½	51½	52½	54	50½	49½	50½	52	54	52½	53	52	52	54
" 17	52	52½	53	53	54	55	53½	53	53½	54	56½	55½	54	54	54
" 18	48½	51½	53	54	54	51½	51	52	53½	54½	53½	53½	53	53	54½
" 19	46½	49½	52	53	54	52	50	51	52½	54	55	53½	52	53	54
" 20	50½	52½	53	53½	54	50	51½	52	53½	54	50	51½	52	53	54
" 21	43½	47	50	51½	53½	45½	46½	49	51	53½	48½	48½	49	51	53
" 22	45½	47	48½	50	53	45½	47	48	50	52½	45½	47	48	49	52½
" 23	41	45	47	49	52	45	44½	46½	48½	52	47	47	47½	48½	52
" 24	39½	44	46½	48½	51½	42½	43½	46	47½	51½	47	47	47	47½	51
" 25	43	44½	46	47½	50½	46½	46	46	47½	50½	47½	47½	48½	48	50½
" 26	45	46	47	48½	50	46	46½	47	48	50¼	45	46	47	47	50
" 27	42	43	45½	47½	50	42½	43	45	47	50	42	43	45	47	50
" 28	39	41	43	46	49½	41½	42	43½	46	49½	42	44	45	46	49½
" 29	37½	39	42	45	49	40	40	41½	44	49	41	41½	42½	44½	49
" 30	40½	41½	43	44½	48½	41½	42	43	44½	48½	42	42½	43	44½	48
" 31	42	42½	43½	45	48	43½	43	44	45	48	44	44	44½	45½	48
Means	46.1	48.6	50.6	52.2	54.1	50.7	49.8	50.2	51.9	54.1	50.6	51.2	51.4	51.9	54.0

RECORD OF SOIL TEMPERATURES AT GRAYLING, APRIL, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
April 1	34½	32	32	32½	33	33½	33½	36½	34½	33½	33½	33	36½	36½	36½	36	35	33½	Light snow.
" 2	30	32	34½	34½	33½	34½	34	40	37	34	33½	34	35	37	36	35½	34	33	
" 3	34	34	35	35½	35	35	35	33	34	34	34½	35	34	35½	34½	34½	34½	34½	Light snow.
" 4	30	32½	33	33½	33½	35	40	39½	35½	34	33½	35	37	40	39	37	35½	35	
" 5	20	32½	33½	34½	34½	35	20	32	33½	33½	34	35	21	32	33	33½	35½	35	Light snow.
" 6	39	31	33	33	33	35	50	44½	38	34	34	35	41	44½	42	40	36	35	
" 7	32	33	34½	35½	35½	36	55	51½	44½	38	36½	36	52	49½	47½	45½	40	36	
" 8	44	39	39	39	39	37	57	47½	44	40	39	38	52	38	38	39	40	36	Light rain.
" 9	44	43½	38	39½	40	38	64	58	51½	46½	41	38	51	63	52	48	44	39	
" 10	39	36	38⅑	40	41	40	65	59	50	44	41½	40	49	56	54	49	48½	40	
" 11	69	43	43	45	44½	42½	60	51½	48½	45½	43½	41½	54	49	48½	47	45	41	
" 12	50	61	46½	44	42	42	30	50	48	46	42	42	43	49	49	42½	42	42	
" 13	40	35½	38	40	41½	42½	41½	45	43½	43½	41	42½	42	49	45	43	41½	42½	
" 14	30	35	37	39	46	42½	54	51½	47	42½	40½	42½	50	51	49	47	47	42	
" 15	34	34	38	42½	43	43½	66	48	48	45	42	42½	52	54	52	44	43	41½	
" 16	38	37	39	42½	42½	42½	66	59	50½	45½	44½	42½	50	54	53	47	44	42	
" 17	42	43	43	45	44	42	62	53	50	47	45	43	58	53	30	47	45	43	
" 18	58	54	50	48	44	43	51	45	46	46	44	43½	71	63	55	49½	46	44	Rain, first of the season.
" 19	64	58	56	55	50	44	54	52	52	51	50	46	61	58	55	52½	50½	46	
" 20	66	52	55	50½	50½	46	51	58	55	53½	51½	46	43	44	46	47	47	47	
" 21	70	66	57½	53½	49	47	51	60	56	52	47	47	40	45	47½	49½	50	48	
" 22	47	53½	50	49½	49	48	40	49	50	49	49	47	36	36	40	44	45	47	
" 23	51	50	52½	46	45	47	40	45	60	50	46	46	46	50	51	52½	49	56½	
" 24	40	54	44	45	46	47	56	60	53	48½	48	46	60	57½	56	53	50	46½	
" 25	50	51½	51½	50½	49½	47	50	54½	54	51½	50	47½	43	43½	44	45½	46	47½	
" 26	33	43½	44	45	46	47½	31	43	43½	44½	45	47	31	39	41½	43	43	46	
" 27	61	63	52½	45	44	45½	46	58	57	53	49½	48	44	44½	46	47½	48	46½	Light rain.
" 28	50	48½	48	47½	47½	46½	49	46	46	46	47	46½	44	44	46	46	46	46½	
" 29	43	48½	43	43	46	46½	32	40	40	42	42	46	34	38	41½	42½	42½	45	
" 30	38	36½	38½	39½	41½	44½	29	44	42	41½	41½	44	38	43	42	42½	42½	44	
Means	44	43.4	42.6	42.5	42.31	41.8	47.4	48.4	46.4	43.8	42.3	42.	44.9	44.9	45.	44.2	43.3	41.1	

RECORD OF SOIL TEMPERATURES AT GRAYLING, MAY, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
May 1	34	36	37½	37½	48½	43	42	44	42	42	41	43	40	37	38	40	41	43	
" 2	44	37	38½	40	41	43	55	54	47	48	43	43	41	56	49½	45	45	43	
" 3	45	57	32½	43	43½	43	60	58	52	46	44	43	51	58	52	46	44	43	
" 4	57	54½	53½	49	47	43	50	54	49	45½	46	45	72	61½	53	49	46½	45	
" 5	72	50	53½	49	46½	45	70	60	59½	53	50½	45	64	48	48½	48½	48	46	
" 6	50	48	57	53½	50	45	64	59	48	48½	48½	46	60	67	55	52½	50	47	
" 7	67	53	60	57½	54	47½	68	63	53	53	53	48	70	65	63	60	56	47	
" 8	83	69½	61	56	54½	48	72	65	63	60	56	48	72	69	61	56	56	43	
" 9	85	72½	65	60	56½	51	75	70	64	60	58½	53	84	68	68	63	59	53	
" 10	80	63	65½	62½	54	53	73	69	62½	62½	62	55	85	75	70	65	63	55	
" 11	81	64	64	64	62	55	60	70	70	64	64	57	70	64	64	64	64	55	
" 12	48	64	56	65	54	57	54	55	58½	59	64	57	65	64	63	62	60	56	
" 13	49	43	43	55½	57½	56	69	63	59	57	57½	56	61	60	59	58	57½	55½	
" 14	54	42	54	55	56	55	55	64	50	59	57	56	46	54	55	56	56	56	
" 15	44	53	54	55	55	55	43	64	64	51	53	55	43	44	44	49	50	54	
" 16	43	35	46	48	50	54	60	53	49	49	49	54	63	56	55	53	53	53	Heavy rain.
" 17	70	53	55	54	54	53½	80	68	63	58	57½	53	75	67	64	61	58	53	
" 18	75	59	50	58	58	54	75	69½	69	67	60	54½	68	69	69	67	65	55	Heavy rain.
" 19	63	61	61½	61	61	56	68	66	64	62	61	57	54	54	55	57	58	57½	
" 20	54	44	54	57	57	57	50	61	60	58	57	56½	41	53½	56	57½	58	56	Misty.
" 21	34	45	48½	51	53	55	44	47	49	51	53	55½	40	47	49	50	52	54	Light rain.
" 22	40	48	45½	49	50	54	53	56	51	49	49	52	49	57	49	49	51	53	
" 23	44	48	48	49	50	53	45	47	48	48	49	52	42	47	48	49	51	42	
" 24	45	31½	42	44	47	51	58	62	54	49	47½	50	42	53	54	54	52½	52	Mist and rain.
" 25	58	52	52	49	47½	50	64	63	62	49	49	50½	46	40	40	48	49	50	
" 26	64	63	58	53	51	50	64	63	58	53½	51	50	59	58	57	55	53	50	
" 27	56	49½	53	52½	52½	51	48	60	50½	51½	51½	51	38	45	48	48	49½	50½	
" 28	34	38	41	44½	46½	51½	40	42	42	43	45	49½	40	44	45½	46	48	58½	Heavy rain.
" 29	35	37	40	43	44	48½	46	49	46½	45	45	48	44	41	47	46	46	48	
" 30	43	42	43	44	45	48	43	43½	44	44	44	47	33	40	40	40	43	47	Heavy rain.
" 31	41	39	40	41½	43	46½	45	43	43½	43	43	46½	44	44	44	44	44	46½	All day rain.
Means	54.6	50.	51.	51.6	51.3	50.8	58.5	58.2	54.7	52.5	51.9	50.9	54.9	55.	53.7	52.8	52.5	50.6	

RECORD OF SOIL TEMPERATURES AT GRAYLING, JUNE, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
June 1	43	43	43	44	44½	46	49	43	44	45	46½	41	49	40	48	47	46	57	Heavy rain.
" 2	48	48	48	46	46	57	48	46	46	46	46	47	48	39	47	48	46	57	Rain.
" 3	48	46	46	46	46½	47	45	51½	49	49	47	47	47	49	49	49	47½	48	Rain.
" 4	43	46½	46½	47	47½	47½	51	52	50	48½	47½	47½	46	48	48	49½	48½	48	Rain.
" 5	47	46½	47	47	47	48	59	57½	53½	49½	48½	48	51	54	55	56½	51½	48	
" 6	55	46½	47	47	48	49	72	61	61	54	50	48	60	63	61	57½	55	49	
" 7	60	55	55½	54½	52	50	68	61	57½	55½	53	51	60	59	59	55	50½	49	Rain.
" 8	56	53	54	55	54½	52	56	55½	55	54	53	52	51	54	55	54	53	57	
" 9	47	49	50	51	52	52	50	50	50	50	51	51	50	51	51	51	51	51	
" 10	48	51	51	51	50	51½	59	56½	54½	52½	51½	51½	57	-----	56	55	54	51½	
" 11	55	53	52½	53½	51½	52	66	63	59	55½	53½	51½	61	68½	58½	57	55½	52½	
" 12	66	51	53½	53	53½	52½	71	76	63	57	54½	52	67	51	57	51½	53	53	
" 13	57	58	58	59	58½	54	63	70	65	60	58	55	64	66	64	63	61	55	
" 14	66	55	55	57	56	56	84	75	62	62	58½	56	56	49	72	72	70	63	
" 15	69	63	63	62½	62	58½	75	79	72	66½	63	58	72	74	73	69½	65	58	
" 16	64	63	63½	63	63½	55	65	65	64	63½	62	59½	66	64	62½	62½	61½	59	
" 17	61	58	59	59½	60	59	70	75	68	63½	60½	59½	65	71	70	68	69	59	
" 18	55	57	59	61	61	59½	76	73	68	64	61½	59½	73	69	68	65½	63½	59	
" 19	70	65	65½	64½	63	60	75	78	73	68	65	60	66	68	69	68	66	60	
" 20	63	58	59	61½	62	60½	75	65	66	63	62	60	65	64	64	62	62	60	
" 21	55	61	61	61½	62	60½	54	66	60	61	61	61	50	57	58	59	60	59½	
" 22	45	55½	55	56½	59½	59	50	58	57	56	57	58	49	53	58	59	55	57	
" 23	46	49	50	52½	54	57	66	66	60½	56	55	57	44	51	52	56	55	57	
" 24	54	51½	52	56½	55½	57	73	71½	63	58½	56½	56½	66	67	66	63½	60	56	
" 25	63	56	55	58½	58½	57	75	73	65½	61½	59½	57	72	69	68	65	63	57	
" 26	71	61½	61½	61	61	59	80	70	73	68½	63	60½	59½	69	69	66	64	61	
" 27	60	61½	61½	61½	61½	60	75	76½	76	71½	65½	63	60	69	69	65	63	60	Rain.
" 28	58	60	60	63	63½	60	80	81½	72	66½	63	60½	75	69	69	65	63	60	
" 29	73	63½	63½	63½	64½	65	86	83	74½	69	65	62	75	78	77	75	73	70	
" 30	73	60	60	63	63½	65	86	81½	75	70	68½	64½	75	66	67	66	67	63	
Means	57.3	54.8	55.5	56.	56.1	55.5	66.7	66.	61.9	58.8	56.9	55.2	59.9	58.3	61.3	60.	58.4	56.5	

RECORD OF SOIL TEMPERATURES AT GRAYLING, JULY, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	14	
July 1	74	57	68	68	68	65	87	85½	78	72	69	65	86	80	79	74	73	66½	
" 2	76	83	81½	77	74	66½	88½	86	79½	74	71	66	84	83	81½	77	74	66½	
" 3	76	72	72½	72½	72½	67	60	70	71	71½	72	67½	60	65	66	68	69	65	Heavy rain.
" 4	56	60	61	61	63½	67	77	75	70	66	65	67	66	66	69	65	65	66	
" 5	66	55	60	62½	63	65	78	80	73	68	64	65	73	63	60	55½	66½	65	
" 6	75	80	72	71	68	65	76	76	76	76	70	70	75	68	68	68	69	66	
" 7	77	68	68	68	68	66	88	86	70	70	69	67	75	66	66	67	69	66½	
" 8	80	70	70	70	69	67½	90	88	80	70	74	67½	86	83	81½	79	77	68	
" 9	80	73	73	73	73	69	91	89	83	77	71	69	86	80	81	74	71	70	
" 10	82	73	73½	73	73	70	86	75	75	74	73	69	60	63	65	67	68	69	Heavy rain.
" 11	60	77	78	72	69	68	76	52	50	55	68	68	60	50	50	56	68	68	
" 12	70	68	69	70	70	68	83	85	78	73	71	69	76	70	70	75	76	69	
" 13	71	66	70	74	72	69	76	86	78	74	72	69	60	76	71	70	74	69	
" 14	58	63	65	66	68	67	75	80	73	68	67	67	66	70	69	67	66	67	
" 15	63	62	64	66	67	67	83	72	72	69	67	67	73	63	66	67	67	67	Light rain.
" 16	80	75	71	69	68	67	83	75	71	69	68	67	85	76	74	71½	70	67	
" 17	76	64	65	67	68	67	80	75	69	68	68	67	73	72	72	70	70	67	
" 18	74	68	68	68	68	67½	85	85	71½	70	69	67½	71	66	68	68	69	67	
" 19	55	60	68	69	69	67½	85	80	75	71	69	67½	75	78	76	74	71	67	
" 20	70	70	70	72	72	67	65	75	71	72	70½	69	60	72	72	75	76	68	
" 21	54	64	64	65	68	68	74	81	74	69	68	68	66	70	70	78	68	68	
" 22	60	63	65	68	68	68	82	80	78	73½	70	68	65	65	67	68	69½	67½	
" 23	65	67	68	69	68	67	75	75	71	69	68	67	70	73	72	71	70	67	
" 24	55	60	62	65½	65½	67½	74	80	79	71½	69	67	65	73	61	64½	66½	66½	
" 25	56	57	61	64½	66½	66½	73	77	71	69	67	66½	65	69	69	67	66	66½	
" 26	60	60	63	65	66	67	75	80	76	69	67	67	67	69	69	68	69	67	
" 27	66	62	64	66	67	67	83	82	80	72	67½	67	75	72	69	67	6[illegible]	67	
" 28	75	63	66	67	67	67	83	72	70	69	68	67	73	70	69	69	66	67	Heavy rain.
" 29	73	63	66	67	67	67	83	73	71	69	68	67	85	75	74	71	70	67	Clouds and rain.
" 30	70	63	65	67	67	66	80	76	74	71½	70	66	73	72	72	70	70	70	
" 31	64	56	56	55	60	64	78	72	70	64	63	64	68	69	68	68	67	63	
Means	68.3	65.9	67.3	68.	68.	67.1	79.8	78.1	73.5	70.1	68.9	67.3	71.7	71.4	69.8	69.3	69.6	67.1	

RECORD OF SOIL TEMPERATURES AT GRAYLING, AUGUST, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
August 1	63	56	58	60	64	64	78	72	70	64	63½	64	68	69	68	67	63	64	
“ 2	65	60	63	63	63	64	75	81	74	68	65	64	65	73	72	68	65	64	
“ 3	65	61	61	63	64	64	73	78	72	68	65	65	61	72	71	69	67	64	Rain.
“ 4	60	50	50	63	65	64	73	78	68	65	64	64	65	73	72	70	67	64	
“ 5	59	56½	60	63	65	64½	71	78	70	75	64	64	73	75	73	69	66	64	
“ 6	59	56	60	63	65	64	71	78	70	65	64	64	73	75	73	69	66	64	
“ 7	60	55	61	64	65	64	80	78	67	67	65	65	65	76	73	70	67	65	
“ 8	65	64	65½	65	66	64½	68	65	65	65	65	64	69	65	65	65	65	64	Rain.
“ 9	76	65	65	65	65	64	70	79	71½	67	65	64	65	74	74	69	68	64	
“ 10	62	60	63	64	66	65	73	81	72	67	66	65	57	74	72	70	67	64	
“ 11	55	56	56	59	65	64	71	80	71½	65	64	65	66	76	73	69	66	64	
“ 12	55	58	60	65	64	64	74	75	67	67½	64	64	73	75	73	68	66	64	
“ 13	60	62	63	65½	65	64	63	65	63	63	64	64	67	62	62	63	64	64	Heavy rain.
“ 14	66	60	60	63	63	64	63	65	65	63	63	63	66	64	65	63	63	64	Heavy rain.
“ 15	54	55	65½	58½	59	63½	66	70	61½	61½	60½	63	63	66½	65	64	62½	62	
“ 16	65	54	54	59	60	64	64	73	67	63	61	63	59	66	65	63	69	62	
“ 17	54	55	55	54	59	63	73	76	67	67	64	63	68	70	68	66	64	62	
“ 18	64	59	60	63½	63½	63	75	71	68	65	63	62	68	68	67	66	64½	62	
“ 19	70	64	64	64	64	63	83	80	73	68	65½	63	70	76	70	67	65	63	
“ 20	74	67	67	68	67½	64	84	76	73	70	68	64	80	70	70	69	66	64	
“ 21	66	69	69	69	68½	65	71	70	70	69	68	65	70	70	70	68	68	65	
“ 22	65	61	63	65	66	65	77	72	72	68	68	65	71	74	72	71	68	65	
“ 23	64	63	64	66	66	65	71	73	68	68	65	65	62	72	69	69½	66	65	
“ 24	57	68	64	65	65	64½	87	79	72	67½	65	64	73	76	73	70	67	64	
“ 25	69	65	66	67	67	65	77	72	70	67	67	65	74	74	72	69	68	64½	
“ 26	66	65	66	67	67	65	77	72	70	75	66	65	74	74	72	69	68	64	
“ 27	66	65	66	66½	67	65	88	78	72	67	66	65	83	70	68	68	68	65	
“ 28	67	65	65	67	68	65	87	77	68	67	67	66	78	72	70	67	67	65	
“ 29	77	68	68	69	69	64	74	81	71	69	66	64	80	80	77	73	71	66	
“ 30	69	69	70	70	70	66½	83	79	76	73½	70	66½	75	75	76	68	68	67	
“ 31	64	63	65	68	68	67	86	78	72	72	68	67	76	78	75	72	69	67	
Means	63.9	61.1	62.5	64.3	65.1	64.4	75.0	75.2	69 7	67.1	65.1	64.3	69.6	72.1	70.5	68.0	66.4	64.2	

RECORD OF SOIL TEMPERATURES AT GRAYLING, SEPTEMBER, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
September 1	64	63	64	66½	67½	66½	84	79	79	73½	67	66	74	76	74	70	68	66½	
" 2	62	62	64	67	68	66½	85	71½	71½	71½	67	66½	70	75	71	69	68	66	
" 3	70	68	68	68	68	66	76	76	71	69	68	66	70	73	69	68	68	66	
" 4	70	66	66	67½	68	66	78	73	72	68	68	66	70	69	69	68	68	66	
" 5	66	63	64	65	66½	65	55	63	63	63	66	65	60	63	64	65	65	65	Heavy rain.
" 6	59	55	58	58	63	64	73	73	66	63	63	61½	68	68	68	66	64	64	Frost.
" 7	64	58	59	62½	62	63½	70	73	67	63	62	63	58	58	60	63	63½	63½	
" 8	58	58	60	63	63½	63	......	79	73	67	64½	63½	74	74½	73	69½	67	63	
" 9	60	62	63	63½	64	64	66	76½	70	65	64½	64	60	71	70	66	63	63	
" 10	64	64	64	65	66	64	88	74	70	67	65½	64	74	72	71½	69	67	64	
" 11	64	63½	63	63	66	65	85	77	72	67	66	65	77	76	74	70	68	64	
" 12	63	62	65½	66½	67	65	81	78	72	70	67	65	80	72	70	69	67	65	
" 13	60	64	64	66	66	65	73	79	73	68	67	65	74	78	78	74	71	65	
" 14	64	63	67	67½	66	65	85	75	70	67½	66½	65	75	75	73	70	68	65	
" 15	74	67	67	67½	68	65	74	75	70	67½	67½	65	65	62	63	63	65	66	
" 16	50	52	52	55½	59	63	50	55	55	56	58	65	50	56	56	56	59	63	
" 17	40	54	56	54	56	60	50	55	55½	56	58	62	50	55	55	56½	58	62	
" 18	40	49	51	54	56½	60	54	50	56	56	56	60	50	55	55	55	55	62	
" 19	45	45	48	51	53	59	57	60	55	55	53½	59½	50	53	53	53	55	59½	
" 20	50	51½	52½	53½	54	55½	41	56	56	55	54½	55½	41	49	49	49	54	57	
" 21	41	44	47	49	51	57	49	55	55	52	51	56½	46	50	52	51	51	56	
" 22	44	44	47	49	49	57	60	64	56	51½	50	55	59	64	56	51	50	54½	
" 23	55	51	52	53	53	55	74	67	61	56	54	55	65	64	63	57	56	55	
" 24	45	52	53½	54	55	55	78	73	64	59	66	56½	68	67	66	63	56	56	
" 25	56	57	57	58	58½	57	60	56	57	57	58	57	53	57	57	57½	57	57	Rainy.
" 26	43	47	50	54	54	57	47	52	51	52	55	56	42	50	50	50	53	56	
" 27	42	44½	47	48	55	56	44	49	49	44	48	55	42	66	57	57	58	53	Rain.
" 28	34	39	41	44	46	53	56	55	51	48	57	53	54	55	54	53	49	53	
" 29	57	45	43	43	48	52	69	60	57	57	51	52	62	58	55	53	51	52	
" 30	55	53	52	51½	56½	52½	57	53	53	53½	52½	52½	57	50	50	51	52	52½	
Means	55.3	55.5	56.8	58.3	60.1	60.7	66.2	66.1	63.0	60.8	60.4	60.8	61.3	63.7	62.5	61.1	60.5	60.7	

RECORD OF SOIL TEMPERATURES AT GRAYLING, OCTOBER, 1889.

Date.	7 A. M.						1 P. M.						7 P. M.						Remarks on Weather.
Depth in inches	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	Open air.	3	6	9	12	24	
October 1	50	52	52	52	52	53	45	49	49	55	51	53	40	55	45	47	46	53	Rain.
" 2	40	43	43	47	46	53	53	57½	57½	53	49½	52½	44	49	49	48	48	52½	
" 3	53	42	44	49	50	52	52	58	53	50	48	52	44	50	49	49	48	52	Rain.
" 4	44	45	46½	47	48	51½	56	48	44	46	48	51	56	43½	43	45	47	50½	
" 5	44	45	45	47	48	51½	55	48	44	46	48	51	50	40	43	44	47	50½	
" 6	33	37	38	42	48½	50	37	42	41½	42½	44	49½	37	47	42	42	44	49	
" 7	37	36	38	41	43	48	53	36	38	41½	44½	47½	50	44	43	40	42	47	
" 8	37	38	38	41½	43	48	53	48½	44	41½	42½	47	50	48	44	43	42	47	Rain.
" 9	44	42	43	43	44	47	60	58½	51	47	45½	47	54	49	48	47	46	47	
" 10	33	44	43	44½	46	48	54	53	49	46	45	48	54	44	44	44	45	48	
" 11	47	44	45	46½	47	48	64	60	54½	52	47	48	64	60	54	54	47	48	
" 12	45	45	47½	48	48½	48	57	56	56	53	50	48	45	46	47	47	48	48	
" 13	45	45½	47½	48	48½	48	45	49	49	48	48	48	48	42	44	45	45	48½	
" 14	35	35	38	43	44	48	53	47	47	43	43½	47½	40	40	40	42½	44	47	
" 15	40	37	40	42	44	47	62	57	49	45½	44	47	50	44	44	48	48	47	Snow.
" 16	62	38	41	43½	45	47½	55	48	46½	45	45	47	48	46	46	48	48	47	
" 17	48	44	45	46	46	47	55	56	51	46	46	47	48	46	47	47	48	47	
" 18	34	46½	43	43	44	47½	54	54	48	45½	44½	47½	50	50	48	45	44	47	
" 19	41	37	40	43	43	47	67	47	47	43	43½	47	49	48	48	47	43	47	
" 20	37	40	41	42½	43½	47	43	46½	44	43	43	46½	40	43	43	43	43	46½	
" 21	29	37	39	41	43	46	39	45	43	41	43	46	39	42	42	43	43	46	
" 22	27	37	39	40	41½	45	33	39	38	40	42	45	33	39	39	40	43	45	
" 23	19	30	30½	31½	32	44	41	44	37	37	39	44	41	37	37	39	39	44	Rain.
" 24	35	34	36	37½	39	43	41	41	41	38	39	43	41	40	40	38	37	43	
" 25	39	39	39	39	39	43	42	48	41	39	39½	42	41	39	40	39	39	42½	
" 26	36	37	39	39½	40	42	43	39	39	39	39	40	40	38	38	38	39	42	
" 27	34	38	39	39	39	42	35	37	38	39	39	42	40	37	38	39	39	42	
" 28	33	35	35½	36½	39	42	47	47	41½	38	39	42	40	44	44	38	38	42	Mist.
" 29	22	35	35	38	39	42	43	38	39	39	39	42	40	39	39	38	39	42	
" 30	40	38	38½	38½	39	42	44	40	40	40	39	42	40	39	39	39	39	42	
" 31	40	38	38	38	39	42	44	40	40	44	39	42	42	37	38	39	39	41	Light rain.
Means	39.1	39.8	40.9	42.6	43.6	46.8	49.2	47.6	45.2	44.1	43.8	46.6	45.1	44.0	43.4	43.4	43.4	46.5	

COMPARATIVE SUMMARY OF SOIL TEMPERATURES OF 1888 AND 1889 AT AGRICULTURAL COLLEGE, FOR THE MONTHS OF MAY TO SEPTEMBER, INCLUSIVE.

Depth in inches..	3.			6.			9.			12.			24.		
Months, etc.	1888.	1889.	Difference.*	1888.	1889.	Difference.	1888.	1889.	Difference.	1888.	1889.	Difference.	1888.	1889.	Difference.
May:															
7 A. M...	50°.4	54°.5	-4°.1	51°.3	55°.4	-4°.1	52°.1	56°.6	-4°.5	52°.2	56°.9	-4°.7	50°.2	55°.3	-5°.1
1 P. M...	60 .2	64 .4	-4 .2	55 .8	60 .4	-4 .6	53 .4	57 .7	-4 .3	52 .2	56 .6	-4 .4	50 .4	55 .4	-5 .0
7 P. M...	57 .7	61 .0	-3 .3	57 .3	61 .0	-3 .7	55 .5	59 .6	-4 .1	53 .8	57 .9	-4 .1	50 .4	55 .5	-5 .1
Means......	56°.1	60°.0	-3°.9	54°.8	58°.9	-4°.1	53°.7	58°.0	-4°.3	52°.7	57°.1	-4°.4	50°.3	55°.4	-5°.1
June:															
7 A. M...	64°.7	59°.0	5°.7	65°.2	59°.7	5°.5	65°.9	60°.2	5°.7	65°.7	60°.1	5°.6	62°.7	58°.3	4°.4
1 P. M...	77 .6	67 .4	10 .2	71 .4	63 .7	7 .7	68 .0	61 .4	6 .6	65 .8	60 .1	5 .7	62 .8	58 .4	4 .4
7 P. M...	74 .3	64 .3	10 .0	71 .6	64 .1	7 .5	70 .0	63 .0	7 .0	67 .7	61 .4	6 .3	62 .7	58 .4	4 .3
Means......	71°.5	63°.6	7°.9	69°.4	62°.5	6°.9	68°.0	61°.5	6°.5	66°.4	60°.5	5°.9	62°.7	58°.4	4°.4
July:															
7 A. M...	68°.6	68.°3	0°.3	69°.9	69°.4	0°.5	70°.8	70°.6	0°.2	70°.7	70°.8	-0°.1	68°.1	68°.8	-0°.7
1 P. M...	80 .7	79 .3	1 .4	75 .3	74 .7	.6	72 .4	72 .0	.4	70 .5	70 .7	- .2	68 .1	68 .8	- .7
7 P. M...	76 .7	75 .5	1 .2	75 .9	75 .3	.6	74 .3	74 .0	.3	72 .0	72 .0	.0	67 .6	68 .6	-1 .0
Means......	75°.3	74°.4	0°.9	73°.7	73°.1	0°.6	72°.5	72°.2	0°.3	71°.1	71°.2	-0°.1	67°.9	68°.7	-0°.8
August:															
7 A. M...	67°.4	66°.8	0°.6	68°.6	68°.2	0°.4	70°.0	69°.7	0°.3	70°.4	70°.1	0°.3	68°.5	68°.2	0°.3
1 P. M...	77 .6	75 .8	1 .8	74 .3	73 .3	1 .0	71 .6	70 .6	1 .0	70 .3	69 .8	.5	68 .5	68 .4	.1
7 P. M...	74 .8	74 .9	- .1	74 .6	74 .6	.0	72 .7	72 .7	.0	71 .3	70 .8	.5	68 .4	68 .1	.3
Means......	73°.3	72°.5	0°.8	72°.5	72°.0	0°.5	71°.4	71°.0	0°.4	70°.7	70°.2	0°.5	68°.5	68°.2	0°.3
Sept.:															
7 A. M...	58°.5	60°.3	-1°.8	60°.9	62°.5	-1°.6	62°.5	64°.4	-1°.9	63°.9	65°.6	-1°.7	64°.1	65°.6	-1°.5
1 P. M...	66 .2	68 .0	-1 .8	63 .6	65 .3	-1 .7	63 .1	64 .6	-1 .5	63 .3	65 .2	-1 .9	64 .2	65 .7	-1 .5
7 P. M...	65 .2	66 .2	-1 .0	65 .4	66 .4	-1 .0	64 .7	66 .0	-1 .3	64 .0	65 .9	-1 .9	64 .1	65 .3	-1 .2
Means......	63°.3	64°.8	-1°.5	63°.3	64°.7	-1°.4	63°.4	65°.0	-1°.6	63°.7	65°.6	-1°.9	64°.1	65°.5	-1°.4

* Differences with a minus sign (-) before them indicate the excess of the monthly mean temperature of 1889 over the corresponding mean temperature of 1888. Those without the minus sign indicate the reverse.

COMPARATIVE SUMMARY OF SOIL TEMPERATURES OF 1888 AND 1889 AT GRAYLING FOR THE MONTHS OF JUNE TO SEPTEMBER, INCLUSIVE.

Depth in inches	3.			6.			9.			12.			24.		
Months, etc.	1888.	1889.	Difference.*	1888.	1889.	Difference.	1888.	1889.	Difference.	1888.	1889.	Difference.	1888.	1889.	Difference.
June:															
7 A. M.	61°.3	54°.8	6°.5	62°.9	55°.5	7°.4	63°.7	56°.0	7°.7	63°.5	56°.1	7°.4	61°.0	55°.5	5°.5
1 P. M.	70 .7	66 .0	4 .7	67 .9	65 .2	2 .7	65 .2	58 .8	6 .4	63 .5	56 .9	6 .6	61 .3	55 .2	6 .1
7 P. M.	72 .8	58 .3	14 .5	71 .0	61 .3	9 .7	68 .5	60 .0	8 .5	65 .3	58 .4	6 .9	61 .0	56 .5	4 .5
Means	68°.3	59°.7	8°.6	67°.3	60°.7	6°.6	65°.8	58°.3	7°.5	64°.1	57°.1	7°.0	61°.1	55°.7	6°.3
July:															
7 A. M.	63°.9	65°.9	-2°.0	66°.5	67°.3	-0°.8	68°.3	68°.0	0°.3	68°.3	68°.0	0°.3	66°.8	67°.1	-0°.3
1 P. M.	75 .5	78 .1	-2 .6	71 .1	73 .5	-2 .4	69 .0	70 .1	-1 .1	68 .0	68 .9	- .9	66 .8	67 .3	- .5
7 P. M.	75 .5	71 .4	4 .1	74 .1	69 .8	4 .3	71 .8	69 .3	2 .5	69 .7	69 .6	.1	66 .6	67 .1	- .5
Means	71°.6	71°.8	-0°.2	70°.6	70°.2	0°.4	69°.7	69°.1	0°.6	68°.7	68°.8	-0°.1	66°.7	67°.1	-0°.4
August:															
7 A. M.	63°.0	61°.1	1°.9	63°.9	62°.5	1°.4	65°.3	64°.3	1°.0	65°.8	65°.1	0°.7	65°.3	64°.4	0°.9
1 P. M.	73 .8	75 .2	-1 .4	68 .5	69 .7	-1 .2	66 .5	67 .1	- .6	65 .6	65 .1	.5	65 .0	64 .3	.7
7 P. M.	71 .5	72 .1	- .6	70 .8	70 .5	.3	69 .2	68 .0	1 .2	67 .4	66 .4	1 .0	64 .5	64 .2	.3
Means	69°.4	69°.4	0°.0	67°.7	67°.5	0°.2	67°.0	66°.5	0°.5	66°.2	65°.5	0°.7	65°.0	64°.3	0°.7
Sept.:															
7 A. M.	56°.6	55°.5	1°.1	56°.4	56°.8	-0°.4	57°.2	58°.3	-1°.1	58°.1	60°.1	-2°.0	59°.4	60°.7	-1°.3
1 P. M.	61 .4	66 .1	-4 .7	60 .2	63 .0	-2 .8	59 .0	60 .8	-1 .8	58 .9	60 .4	-1 .5	59 .3	60 .8	-1 .5
7 P. M.	60 .1	63 .7	-3 .6	57 .7	62 .5	-4 .8	58 .3	61 .1	-2 .8	58 .3	60 .5	-2 .2	59 .3	60 .7	-1 .4
Means	59°.4	61°.8	-2°.4	58°.1	60°.8	-2°.7	58°.2	60°.1	-1°.9	58°.4	60°.3	-1°.9	59°.3	60°.7	-1°.4

---

* Differences with a minus sign (-) before them indicate the excess of the monthly mean temperature of 1889 over the corresponding mean temperature of 1888. Those without the minus sign indicate the reverse.

COMPARATIVE SUMMARY OF SOIL TEMPERATURES AT AGRICULTURAL COLLEGE AND AT GRAYLING, FOR THE MONTHS OF APRIL TO OCTOBER INCLUSIVE, 1889.

Depth in inches	3.			6.			9.			12.			24.		
Months, etc.	Agr'l College.	Grayling.	Difference.	Agr'l College.	Grayling.	Difference.	Agr'l College.	Grayling.	Difference.	Agr'l College.	Grayling.	Difference.	Agr'l College.	Grayling.	Difference.
April:															
7 A. M.	43°.7	43°.4	0°.3	44°.7	42°.6	2°.1	45°.7	42°.5	3°.2	46°.0	42°.3	3°.7	44°.9	41°.8	3°.1
1 P. M.	52 .6	48 .4	4 .2	49 .1	46 .4	2 .7	46 .6	43 .8	2 .8	45 .8	42 .3	3 .5	44 .8	42 .0	2 .8
7 P. M.	49 .9	44 .9	5 .0	50 .0	45 .0	5 .0	48 .7	44 .2	4 .5	46 .8	43 .3	3 .5	44 .6	41 .1	3 .5
Means	48°.7	45°.6	3°.1	47°.9	44°.7	3°.2	47°.0	43°.5	3°.5	46°.2	42°.6	3°.6	44°.8	41°.6	3°.2
May:															
7 A. M.	54°.5	50°.0	4°.5	55°.4	51°.0	4°.4	56°.6	51°.6	5°.0	56°.9	51°.3	5°.6	55°.3	50°.8	4°.5
1 P. M.	64 .4	58 .2	6 .2	60 .4	54 .7	5 .7	57 .7	52 .5	5 .2	56 .6	51 .9	4 .7	55 .4	50 .9	4 .5
7 P. M.	61 .0	55 .0	6 .0	61 .0	53 .7	7 .3	59 .6	52 .8	6 .8	57 .9	52 .5	5 .4	55 .5	50 .6	4 .9
Means	60°.0	54°.4	5°.6	58°.9	53°.1	5°.8	58°.0	52°.3	5°.7	57°.1	51°.9	5°.2	55°.4	50°.8	4°.6
June:															
7 A. M.	59°.0	54°.8	4°.2	59°.7	55°.5	4°.2	60°.2	56°.0	4°.2	60°.1	56°.1	4°.0	58°.3	55°.5	2°.8
1 P. M.	67 .4	66 .0	1 .4	64 .1	61 .9	2 .2	61 .4	58 .8	2 .6	60 .1	56 .9	3 .2	58 .4	55 .2	3 .2
7 P. M.	64 .3	58 .3	6 .0	64 .1	61 .3	2 .8	63 .0	60 .0	3 .0	61 .4	58 .4	3 .0	58 .4	56 .5	1 .9
Means	63°.6	59°.7	3°.9	62°.6	59°.6	3°.0	61°.5	58°.3	3°.2	60°.5	57°.1	3°.4	58°.4	55°.7	2°.7
July:															
7 A. M.	68°.3	65°.9	2°.4	69°.4	67°.3	2°.1	70°.6	68°.0	2°.6	70°.8	68°.0	2°.8	68°.8	67°.1	1°.7
1 P. M.	79 .3	78 .1	1 .2	74 .7	73 .5	1 .2	72 .0	70 .1	1 .9	70 .7	70 .1	.6	68 .8	67 .3	1 .5
7 P. M.	75 .5	71 .4	4 .1	75 .3	69 .8	5 .5	74 .0	69 .3	4 .7	72 .0	69 .3	2 .7	68 .6	67 .1	1 .5
Means	74°.4	71°.8	2°.6	73°.1	70°.2	2°.9	72°.2	69°.1	3°.1	71°.2	69°.1	2°.1	68°.7	67°.2	1°.5
August:															
7 A. M.	66°.8	61°.1	5°.7	68°.2	62°.5	5°.7	69°.7	64°.3	5°.4	70°.1	65°.1	5°.0	68°.2	64°.4	3°.8
1 P. M.	75 .8	75 .2	.6	73 .3	69 .7	3 .6	70 .6	67 .1	3 .5	69 .8	65 .1	4 .7	68 .4	64 .3	4 .1
7 P. M.	74 .9	72 .1	2 .8	74 .6	70 .5	4 .1	72 .7	68 .0	4 .7	70 .8	66 .4	4 .4	68 .1	64 .2	3 .9
Means	72°.5	69°.4	3°.1	72°.0	67°.5	4°.5	71°.0	66°.5	4°.5	70°.2	65°.5	4°.7	68°.2	64°.3	3°.9
Sept.:															
7 A. M.	60°.3	55°.5	4°.8	62°.5	56°.8	5°.7	64°.4	58°.3	6°.1	65°.6	60°.1	5°.5	65°.6	60°.7	4°.9
1 P. M.	68 .0	66 .1	1 .9	65 .3	63 .0	2 .3	64 .6	60 .8	3 .8	65 .2	60 .4	4 .8	65 .7	60 .8	4 .9
7 P. M.	66 .2	63 .7	2 .5	66 .4	62 .5	3 .9	66 .0	61 .1	4 .9	65 .9	60 .5	5 .4	65 .3	60 .7	4 .6
Means	64°.8	61°.8	3°.0	64°.7	60°.8	3°.9	65°.0	60°.1	4°.9	65°.6	60°.3	5°.3	65°.5	60°.7	4°.8
October:															
7 A. M.	46°.1	39°.8	6°.3	48°.6	40°.9	7°.7	50°.6	42°.6	8°.0	52°.2	43°.6	8°.6	54°.1	46°.8	7°.3
1 P. M.	50 .7	47 .6	3 .1	49 .8	45 .2	4 .6	50 .2	44 .1	6 .1	51 .9	43 .8	8 .1	54 .1	46 .6	7 .5
7 P. M.	50 .6	44 .0	6 .6	51 .2	43 .4	7 .8	51 .4	43 .4	8 .0	51 .9	43 .4	8 .5	54 .0	46 .5	7 .5
Means	49°.1	43°.8	5°.3	49°.9	43°.2	6°.7	50°.7	43°.4	7°.3	52°.0	43°.6	8°.4	54°.1	46°.6	7°.5

IV.—SUNSHINE TEMPERATURE.

The meteorologist seeks to find the temperature of the air in the shade, removed as far as possible from the direct influence of the sun's rays, and for this purpose much ingenuity is exercised to estimate as far as possible the direct heat rays of the sun. For the meteorologist such a method is very valuable. We have so long dwelt upon this shade temperature as the most important datum in the thermometry of physical existence that we forget the more important fact of the sunshine temperature. For the living thing, whether animal or vegetable, the sunshine temperature is even more important than that in the shade. Vigor in living is the child of the sunshine. "Walk in the light" is the condition of excellence alike in the physical and in the moral world. In the vegetable kingdom the importance of direct sunlight is fully recognized. Other things being equal, the vigor and development of the plant is directly proportionate to the amount and intensity of the sunlight. Our grains, our fruits, and all our farm products are packed full of sunshine. No shade temperature can compare in importance with this sunshine temperature. Why, then, should observations by the thermometer be limited to the shade? Can the conditions of vegetable growth be properly studied without a full and complete study of the thermometry and psychrometry of the sunshine as well as the shade?

Some observations looking in this direction have been taken during the year, but they are imperfect and unsatisfactory as all such observations must be when better methods and more complete results are readily obtainable. These observations relate to the maximum and minimum temperatures taken in open air and with full exposure to the sun. Two sun thermometers in vacuum were used, one with bright or mercurial bulb and the other blackened by coating of lampblack. These were actinometers rather than thermometers. Two other self-recording thermometers with bulbs of black glass were used, one at the College, the other at Grayling. All of these thermometers were placed ten inches above the ground, and results read off daily. A minimum thermometer, placed four inches above the ground, was used at each station from April to November.

No discussion of the results of these observations is attempted, A fuller set of observations of the temperature of wet and dry bulb thermometers in the sunshine, as well as the maxima and minima of temperatures in the same way will be made next year, and some discussion of these fuller observations will then be attempted. The observations as taken this year are given in the following tables:

SUNSHINE TEMPERATURES.

RECORD OF MAXIMUM AND MINIMUM THERMOMETERS AT AGRICULTURAL COLLEGE, MICHIGAN, 1889.

Days of Month.	April.					May.					June.			
	Maximum.					Maximum.					Maximum.			
	Black bulb.		Clear glass bulb.			Black bulb.		Clear glass bulb.			Black bulb.		Clear glass bulb in vacuum.	
	In vacuum.	In air.	In vacuum.	In air.	Minimum.	In vacuum.	In air.	In vacuum.	In air.	Minimum.	In vacuum.	In air.		Minimum.
1	------	------	------	------	------	87	55	62	60	20	80	58	61	40
2	------	------	------	------	------	84	52	57	55	36	87	53	63	42
3	------	------	------	------	------	126	75	86	80	24	92	66	67	35
4	------	------	------	------	------	129	81	90	88	34	129	70	80	35
5	------	------	------	------	------	135	85	95	88	36	134	79	90	46
6	------	------	------	------	------	138	89	102	92	51	134	86	93	36
7	------	------	------	------	------	138	93	102	99	58	72	64	67	55
8	------	------	------	------	------	134	93	115	96	63	77	59	63	58
9	------	------	------	------	------	148	95	107	101	60	137	86	97	50
10	------	------	------	------	------	142	96	107	99	48	98	68	72	48
11	------	------	------	------	------	136	85	99	90	39	135	82	94	50
12	------	------	------	------	------	134	87	94	90	------	139	87	98	48
13	115	63	71	68	------	78	66	66	70	45	137	91	100	54
14	118	66	75	72	19	132	87	95	93	47	134	94	99	53
15	127	74	80	77	25	77	67	67	70	42	140	92	101	62
16	129	74	84	83	24	108	76	82	78	52	130	78	93	58
17	130	84	90	93	27	142	96	106	102	63	144	95	101	62
18	128	82	90	87	41	147	99	109	104	66	137	89	97	52
19	130	80	87	82	58	133	82	92	83	57	143	93	103	66
20	142	84	92	91	40	129	78	90	82	47	129	89	94	50
21	128	70	82	41	41	89	56	76	64	39	134	74	86	63
22	118	68	79	77	22	114	71	76	72	34	91	63	73	50
23	113	74	86	73	34	123	70	81	73	28	115	78	82	36
24	113	71	81	76	39	132	80	90	84	42	106	79	85	41
25	88	50	52	54	37	94	72	76	69	27	134	92	97	43
26	126	73	82	82	35	131	81	88	85	28	123	93	98	53
27	86	54	55	53	36	77	58	62	60	49	146	100	105	57
28	108	64	70	67	44	121	68	77	72	28	146	98	105	59
29	85	52	57	54	35	55	44	46	51	32	146	101	107	57
30	80	51	57	64	32	69	40	54	48	32	152	104	110	63
31	------	------	------	------	------	77	56	57	61	37	------	------	------	------
Means	114.6	68.5	76.1	73.7	34.6	114.8	75.3	84.4	79.3	42.1	123.3	82.2	89.4	50.7

SUNSHINE TEMPERATURES.

RECORD OF MAXIMUM AND MINIMUM THERMOMETERS AT AGRICULTURAL COLLEGE, MICHIGAN, 1889.

Days of Month.	July.				August.				September.				October.		
	Maximum.				Maximum.				Maximum.				Maximum.		
	Black bulb.		Clear glass bulb in vacuum.	Minimum.	Black bulb.		Clear glass bulb in vacuum.	Minimum.	Black bulb.		Clear glass bulb in vacuum.	Minimum.	Black bulb.		Minimum.
	In vacuum.	In air.			In vacuum.	In air.			In vacuum.	In air.			In vacuum.	In air.	
1	145	103	108	59	138	91	99	49	144	103	109	58	120	74	53
2	149	107	110	60	140	92	100	64	143	100	107	54	122	77	42
3	149	93	98	68	138	88	99	53	142	98	106	66	130	82	33
4	147	89	99	51	142	93	102	45	143	97	104	64	129	77	29
5	143	101	96	48	142	94	100	50	116	79	84	68	118	69	42
6	141	97	104	53	137	93	99	41	139	97	102	42	105	62	33
7	139	97	105	54	138	97	100	41	142	98	103	39	116	65	24
8	149	100	110	60	109	84	87	51	133	97	100	40	124	70	15
9	152	106	113	62	129	87	96	64	140	99	105	45	119	75	25
10	144	99	107	62	143	92	100	45	146	102	109	58	117	74	24
11	143	101	106	55	133	89	93	35	140	102	107	50	110	79	39
12	146	100	108	62	138	96	100	37	139	99	105	46	91	65	35
13	80	73	78	50	111	80	85	54	131	97	101	46	128	69	37
14	141	94	100	52	129	87	92	62	143	97	107	59	123	71	25
15	137	94	100	44	136	88	94	48	112	84	90	64	123	77	18
16	142	96	101	46	140	92	97	45	108	77	80	42	125	77	20
17	142	99	102	66	140	94	100	40	111	75	*	35	117	76	37
18	133	97	------	67	130	90	98	44	76	57	------	36	118	70	20
19	134	94	94	61	138	96	106	60	132	81	------	36	123	76	20
20	149	100	104	51	137	96	105	62	105	78	------	52	96	58	36
21	140	96	109	54	138	96	99	68	119	71	------	32	57	97	16
22	148	95	104	48	138	95	104	47	128	80	------	18	55	43	26
23	135	91	97	41	144	100	108	44	142	90	------	37	113	63	9
24	143	96	102	42	138	100	136	48	137	97	------	38	89	55	9
25	135	93	99	50	135	102	108	50	106	66	------	61	88	57	40
26	144	98	108	56	120	95	97	53	117	67	------	31	87	59	41
27	138	94	99	54	145	102	109	52	116	66	------	24	52	42	34
28	122	81	89	54	141	101	106	48	130	84	------	33	93	60	28
29	------	----	------	53	144	105	101	46	84	72	------	33	58	46	19
30	145	96	102	----	141	104	109	54	75	64	------	53	52	45	37
31	------	----	------	47	138	101	107	54	------	----	------	----	56	47	40
Means	139.8	95.9	101.9	54.3	135.8	94.2	101 3	50.1	124.6	85.8	101 2	45.3	101.8	66.4	29.2

* Thermometer broken.

RECORD OF MAXIMUM BLACK BULB AND MINIMUM THERMOMETERS IN OPEN AIR AT GRAYLING, APRIL TO OCTOBER INCLUSIVE, 1889.

Day of Month.	Maximum—Black Bulb.							Minimum.						
	April.	May.	June.	July.	Aug.	Sept.	Oct.	April.	May.	June.	July.	Aug.	Sept.	Oct.
1	......	60	56	111	90	94	66	......	28	39	60	42	39	50
2	......	62	82	106	88	93	53	......	33	40	60	61	42	32
3	......	65	64	80	86	94	64	......	30	41	55	48	62	42
4	......	85	74	82	92	96	60	......	28	41	43	40	61	29
5	......	......	76	94	94	88	54	......	55	42	43	34	55	39
6	......	......	86	98	98	87	66	......	59	31	56	32	39	30
7	......	......	78	102	94	92	68	......	69	50	61	39	53	30
8	......	92	62	111	82	93	75	......	35	49	60	55	50	20
9	......	94	60	112	92	96	73	......	57	42	68	65	42	35
10	......	96	68	102	90	99	74	30	59	46	60	45	64	22
11	......	95	72	112	90	101	74	30	37	49	61	30	54	34
12	......	95	88	110	95	103	68	30	36	48	49	35	46	35
13	......	93	90	110	74	102	56	20	39	60	50	50	45	19
14	......	83	94	98	80	98	68	10	39	69	60	60	49	12
15	65	68	96	95	90	97	65	20	39	69	52	40	63	19
16	67	86	87	92	92	86	66	12	40	58	38	45	29	20
17	86	92	90	96	88	85	63	32	55	51	40	39	42	38
18	88	99	95	100	92	84	60	42	55	44	65	49	45	14
19	78	98	94	88	100	86	64	55	55	65	76	65	34	12
20	82	92	89	95	98	84	54	30	59	41	54	69	45	26
21	72	89	89	98	88	83	58	43	44	60	43	69	34	21
22	76	80	78	91	94	82	50	45	33	50	48	42	22	25
23	68	78	72	94	93	83	52	32	39	31	43	62	46	10
24	72	70	80	96	94	86	50	50	31	31	48	42	40	15
25	76	76	91	92	102	80	48	49	20	30	44	58	55	32
26	82	78	84	98	93	64	48	33	24	50	39	58	39	20
27	74	76	90	89	103	64	50	30	50	59	42	58	32	34
28	55	74	92	88	96	74	51	31	30	55	43	50	23	18
29	58	65	106	88	99	84	48	32	20	51	42	51	28	25
30	55	59	110	82	96	60	46	28	33	59	61	62	52	12
31	......	56	......	84	98	......	46	......	31	......	61	39	......	33
Means	72.1	80.6	83.1	96.9	92 0	87.3	59.3	35.3	40.7	48.4	50.6	49.5	44.3	25.9

V.—SUNSHINE RECORD.

Records of the sunshine have been kept, Pickering's Sunshine Recorders being used for this purpose. The value of such records as furnishing one of the physical data for studying the conditions of agriculture in a given region, will be obvious to any thoughtful mind. The more nearly agriculture is brought down to an absolute and determined physical basis, the more certainly we shall come to a knowledge of all the laws governing its complicated processes. As a contribution to this end the following record of the hours of sunshine by months for the season of 1889, is presented:

HOURS OF SUNSHINE DAILY AT AGRICULTURAL COLLEGE, FROM APRIL TO OCTOBER, FOR 1888 AND 1889.

Day of Month.	April.		May.		June.		July.		August.		September.	
	1888.	1889.	1888.	1889.	1888.	1889.	1888.	1889.	1888.	1889.	1888.	1889.
1	4	0	4½	4½	7	¼	13	10	13	5	10	10
2	7	0	11	0	8	0	13	0	¼	9	12	8
3	6	2	5	13	12	1¼	13	3	3	12½	12	5
4	11	3	0	11	14	2	12	11	7	13	10	6
5	3	0	10	13	12	9	13	8	9	9	12	1
6	12	12	10	12	8	14	5	13	4	13	12	12
7	12	12	¼	13	9	0	10	12	4	10½	8	12
8	11	4	0	12½	12	0	0	11	8	2	11	11
9	6	3	1	8	4	5	3½	9	8	3	12	7
10	0	12	7	8	5	0	9	5	9	8	5	10
11	7	0	7	9	12	11	11	6	7	13	10	12
12	13	0	0	10	10	12	3	13	3½	13	8	12
13	3	6	4	0	4	11	12	10	12	2	12	0
14	6	13	½	9	8	1½	2	0	10	0	12	6
15	¼	13	5	2	14	5	10	9	0	6	7	4
16	13	13	13	¼	14	¼	8	13	12	6	8	5
17	0	10	4	6	12	4	7	7	13	8	2	4
18	8	5	0	10	10	4	8	2	13	11	0	3
19	0	6	7	7	14	9	8	1	13	10	9	10
20	4	13	14	9	14	5	12	2	10	10	7	0
21	3	13	14	1½	10	0	4	8	5	5	10	2
22	1	13	14	3½	14	3	9	8	13	9	8	10
23	10	4	5	7	5	6	11	11	13	9	5	8
24	13	0	8	8	14	0	11	10	13	4	12	12
25	13	2	0	4	2	6	9	10	13	6	4	2
26	8	10	9	10	6	5	0	2	9	6	4	7
27	13	0	3	0	0	10	5	8	9	11	3	8
28	13	0	¾	13	0	10	12	4	8	13	0	12
29	10	0	12	0	5	10	7	0	7	13	12	3
30	0	0	12	0	10	13	8	5	9	13	0	0
31	......	......	4	0	......	......	3½	9	0	12	......	......
Totals	210	169	185	204	269	168	252	220	258	265	237	202

SUMMARY OF METEOROLOGICAL OBSERVATIONS AT THE MICHIGAN AGRICULTURAL EXPERIMENT STATION, FOR THE YEAR 1888.

IN CONTINUATION OF THE SAME SERIES OF OBSERVATIONS RECORDED FOR THE MICHIGAN AGRICULTURAL COLLEGE SINCE 1863.

BY R. C. KEDZIE, PROFESSOR OF CHEMISTRY AND CHEMIST OF THE STATION.

[Latitude 42° 43′ 56″, longitude 7° 25′ 59.61″, height above the sea 834 feet.]

	Mean Daily Temperature in the Open Air.	Percentage of Humidity, Saturation=100.	Pressure of Vapor of Water in Inches of Mercury.	Height of Barometer, reduced to Temperature of 32° F.	Percentage of Cloudiness.	Amount of Rain and Melted Snow in Inches.	Snow fall in Inches.	Number of Thunderstorms.
January	15°.40	89	------	29.202	77	2.18	12½	----
February	21 .95	85	------	29.070	64	1.70	4	----
March	27 .03	79	------	29.154	62	1.88	4½	----
April	44 .03	61	------	29.202	49	1.15	¼	1
May	53 .65	68	------	29.023	64	3.66	------	1
June	67 .89	72	------	29.032	44	2.51	------	2
July	70 .53	71	------	29.119	43	2.40	------	2
August	67 .55	71	------	29.103	42	1.87	------	1
September	57 .76	71	------	29.128	45	1.89	------	----
October	45 .70	76	------	29.027	70	3.00	------	3
November	38 .50	82	------	29.167	62	3.12	3¼	1
December	30 .39	83	------	29.070	72	1.20	2¼	----
Year	45°.03	76	------	29.108	58	26.56	26¾	11

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1........	22	15	12	16⅓	86	82	80	.101	.070	.060	28.590	28.672	28.896	28.719
2........	8	12	11	10⅓	100	80	100	.062	.060	.071	29.089	29.129	29.123	29.114
3........	3	21	20	14⅔	100	86	85	.050	.096	.091	29.187	29.256	29.212	29.218
4........	24	31	27	27⅓	87	79	88	.111	.136	.129	28.999	28.925	29.133	29.052
5........	27	30	27	28	88	89	100	.129	.148	.147	29.372	29.335	29.236	29.314
6........	32	35	32	33	100	90	100	.181	.183	.181	28.845	28.895	28.907	28.882
7........	35	33	31	33	90	79	100	.183	.150	.174	28.893	28.952	28.982	28.942
8........	26	27	22	25	100	76	86	.141	.111	.101	29.085	29.223	29.394	29.234
9........	16	22	20	19⅓	100	86	85	.090	.096	.091	29.437	29.311	29.191	29.313
10........	17	15	6	12⅔	83	82	100	.078	.070	.057	29.023	29.070	29.268	29.120
11........	1	10	7	6	100	79	100	.046	.054	.060	29.482	29.597	29.652	29.577
12........	3	17	23	14⅓	100	67	100	.050	.063	.123	29.595	29.302	28.949	29.282
13........	36	13	7	18⅔	80	62	100	.170	.048	.060	28.723	29.146	29.419	29.096
14........	2	22	18	14	100	70	100	.048	.075	.098	29.448	29.333	29.246	29.309
15.......	8	12	-6	4⅔	78	80	100	.048	.060	.033	29.382	29.600	29.754	29.579
16........	-5	12	4	3⅔	100	80	100	.035	.057	.052	29.849	29.809	29.711	29.790
17........	11	15	10	12	80	82	100	.057	.070	.068	29.252	29.143	29.231	29.209
18........	13	18	7	12⅔	81	100	100	.063	.094	.060	29.254	29.258	29.341	29.284
19........	8	12	15	11⅔	100	100	82	.062	.075	.070	29.285	29.128	29.118	29 177
20........	3	9	10	7⅓	100	100	79	.050	.062	.068	29.257	29.305	29.241	29.268
21........	-15	10	-8	-4⅓	100	78	100	.023	.048	.031	29.652	29.631	29.621	29.635
22........	-6	18	1	4⅓	100	65	100	.033	.055	.046	29.625	29.536	29.391	29.517
23........	10	22	15	15⅔	79	86	82	.054	.101	.070	29.338	29.246	29.409	29.331
24........	-9	15	11	5⅔	100	66	100	.029	.059	.071	29.577	29.493	29.338	29.469
25........	15	27	24	12	82	88	86	.070	.129	.106	28.811	28.602	28.587	28.666
26........	9	18	15	14	100	83	82	.065	.078	.070	29.095	29.087	29.098	29.093
27........	11	12	-1	7⅓	100	80	100	.068	.060	.042	29.098	29.285	29.188	29.190
28........	-1	17	12	9⅓	100	67	80	.042	.063	.060	29.280	29.345	29.265	29.297
29........	19	25	24	22⅔	69	61	87	.071	.077	.111	29.033	28.952	28.935	28.973
30........	26	29	29	28	88	89	100	.123	.142	.160	28.915	28.870	28.887	28.891
31........	26	29	29	28	100	89	89	.141	.142	.142	29.032	29.117	29.203	29.117
Sums....	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means...	------	------	------	15.40	93	81	93	.080	.088	.087	--------	--------	--------	29.170
Average.........................					89			.085			------------------------------------			

JANUARY, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7. A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
100	St.	90	St.	100	St.	s w	12	s w	16	s w	8	22	8	--------	--------	------	------
100	St.	90	St.	100	St.	s w	8	s w	2	s w	9	12	3	In night	--------	.05	½
15	St.	100	St.	100	St.	s w	1	s w	8	s w	3	24	3	--------	--------	------	------
100	St.	100	St.	100	St.	s e	6	s e	3	n e	7	31	24	--------	--------	------	------
100	St.	100	St.	100	Nim.	n	6	e	7	e	4	32	26	6 p. m.	--------	------	------
100	Nim.	100	Fog.	100	Nim.	s e	2	----	0	e	2	35	32	--------	11 p. m.	.88	------
100	St.	100	St.	100	Nim.	s w	3	n w	2	----	0	36	26	6 p. m.	--------	------	------
100	Nim.	60	Cu.	100	St.	n w	6	n w	11	----	0	32	16	--------	8 a. m.	.15	1½
100	St.	100	St.	100	St.	n	2	s w	12	s w	4	24	16	--------	--------	------	------
70	Cu. St.	100	Nim.	40	St.	s w	16	s w	16	s w	6	17	0	8 a. m.	7 p. m.	.10	1
10	St.	80	Cu. St.	100	St.	n w	4	w	12	w	5	10	1	--------	--------	------	------
10	St.	100	St.	100	Nim.	s e	9	s e	12	s e	16	36	3	4 p. m.	--------	------	------
100	Nim.	100	Nim.	100	St.	s w	28	w	28	w	12	36	-1	--------	3 p. m.	.40	
90	St.	90	St.	100	Nim.	s	4	e	4	s e	2	32	2	7 p. m.	12 p. m.	.20	2
60	St.	20	Cu.	00	--------	w	12	n w	12	w	2	12	-11	--------	--------	------	------
90	St.	30	St.	100	St.	n w	1	s w	2	e	4	14	-5	--------	--------	------	------
100	Nim.	100	Nim.	20	St.	n e	3	w	7	w	3	16	6	7 a. m.	--------	------	------
100	Nim.	100	Nim.	10	St.	w	4	w	12	----	0	19	0	--------	4 p. m.	.10	1
100	Cir. St.	100	Nim.	100	St.	s w	8	s	8	s w	8	14	3	--------	--------	------	------
100	St.	90	St.	100	St.	n w	8	n w	6	n w	6	14	-16	--------	--------	------	------
10	St.	00	--------	30	St.	w	1	----	0	----	0	11	-15	--------	--------	------	------
00	--------	00	--------	100	St.	e	1	s	1	n w	2	18	-6	--------	--------	------	------
100	St.	100	Nim.	100	St.	s	4	s w	12	n w	4	22	-11	--------	--------	------	------
10	St.	80	St.	50	St.	e	2	s e	7	s	12	17	-9	--------	--------	------	------
100	Nim.	100	Nim.	50	St.	s e	8	w	12	w	16	26	8	7 a. m.	6 p. m.	.30	3
10	St.	10	St.	100	Nim.	w	12	w	8	n	1	25	8	--------	--------	------	------
100	St.	00	--------	10	St.	n e	1	n w	6	n w	5	26	-14	--------	--------	------	------
00	--------	5	St.	90	St.	n w	1	w	1	w	1	19	-1	--------	--------	------	------
100	St.	100	St.	100	St.	s e	1	s e	1	----	0	26	19	--------	--------	------	------
100	St.	100	St.	100	St.	----	0	s	1	e	1	29	26	--------	--------	------	------
100	St.	100	St.	100	St.	----	0	n w	1	----	0	29	26	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	2.18	12½
73	--------	76	--------	81	--------	----	----	----	----	----	----	23.10	5.39	--------	--------	------	------
77																	

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	29	32	30	30⅓	89	89	78	.142	.155	.130	29.351	29.391	29.441	29.394
2	26	32	21	26⅓	100	79	100	.141	.143	.113	29.431	29.363	29.371	29.388
3	22	33	31	28⅔	100	89	89	.118	.162	.155	29.345	29.306	29.245	29.299
4	27	35	31	31	100	79	100	.147	.155	.174	28.872	28.715	28.732	28.773
5	22	26	17	21⅔	100	75	83	.118	.100	.078	28.985	29.014	29.045	29.015
6	13	22	23	19⅓	100	72	86	.078	.084	.106	29.128	29.120	28.861	29.036
7	28	31	27	29⅔	88	89	76	.135	.155	.111	28.768	28.547	28.705	28.673
8	6	7	1	4⅔	100	77	100	.057	.045	.046	28.783	28.787	28.898	28.823
9	–16	2	–16	–10	100	72	100	.022	.034	.022	29.187	29.255	29.203	29.215
10	–2	12	13	7⅔	67	61	81	.027	.045	.063	29.128	29.002	29.045	29.058
11	–7	19	2	4⅔	100	69	100	.032	.071	.048	29.105	29.092	29.098	29.098
12	–2	30	27	18⅓	100	78	76	.040	.130	.111	29.090	28.992	29.085	29.059
13	26	45	40	37	75	61	73	.105	.235	.182	29.095	29.042	28.992	29.043
14	35	21	7	21	100	100	77	.204	.113	.045	29.067	29.280	29.545	29.297
15	–10	4	–1	–2⅓	100	100	100	.028	.050	.042	29.869	29.878	29.783	29.843
16	6	33	33	24	75	61	70	.041	.113	.131	29.479	29.185	29.092	29.252
17	23	38	33	31⅓	100	72	79	.123	.165	.150	29.115	29.025	28.912	29.017
18	27	41	30	32⅔	100	49	89	.147	.126	.148	29.032	29.125	29.157	29.105
19	30	38	39	35⅔	89	81	100	.148	.186	.238	29.032	28.787	28.677	28.832
20	35	24	23	27⅓	80	87	86	.162	.111	.106	28.599	28.743	28.870	28.734
21	21	28	23	24	100	76	100	.113	.111	.123	29.175	29.196	29.288	29.220
22	18	40	35	31	100	46	70	.098	.110	.142	29.458	29.361	29.279	29.366
23	33	44	30	35⅔	89	60	89	.168	.173	.148	29.214	29.193	29.228	29.212
24	27	45	37	36⅓	100	68	100	.147	.196	.221	29.138	28.907	28.522	28.856
25	42	32	17	30⅓	90	89	83	.235	.162	.078	28.259	28.399	28.577	28.412
26	10	10	4	8	100	100	100	.068	.068	.052	28.743	28.843	28.968	28.851
27	3	8	4	5	100	78	74	.050	.048	.038	29.000	29.115	29.305	29.140
28	5	23	16	14⅔	75	47	83	.041	.056	.074	29.352	29.162	29.122	29.212
29	26	40	35	33⅔	75	56	80	.117	.139	.162	29.092	29.209	29.241	29.181
30	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
31	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	21.95	93	74	87	.105	.119	.112	--------	--------	--------	29.069
Average					85			.112			--------			

FEBRUARY, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
100	St.	100	St.	100	St.	n	1	----	0	----	0	32	26	--------	--------	------	------
100	St.	60	St.	00	--------	s e	4	s	4	----	0	32	13	--------	--------	------	------
100	Fog.	100	St.	100	St.	----	0	e	6	e	6	32	22	--------	--------	------	------
100	St.	100	St.	100	Nim.	e	2	e	3	w	5	35	22	4 p. m.	10 p. m.	------	⅓
100	St.	30	Cu.	00	--------	n	5	n w	8	n w	2	28	8	--------	--------	------	------
100	St.	100	St.	100	St.	s w	2	s w	8	s	12	28	13	--------	--------	------	------
100	St.	100	Nim.	100	St.	s w	12	s w	4	w	12	31	6	10 a. m.	6 p. m.	.20	2
50	Cu.	90	St.	100	St.	s w	12	s w	16	s w	16	10	-17	--------	--------	------	------
20	St.	00	--------	00	--------	----	0	s w	4	----	0	2	-19	--------	--------	------	------
100	St.	100	St.	100	St.	----	0	s w	2	----	0	13	-10	--------	--------	------	------
30	Cir. St.	10	St.	00	--------	----	0	s w	1	----	0	24	-7	--------	--------	------	------
40	St.	75	St.	100	St.	s	1	s	5	s w	4	30	-2	--------	--------	------	------
00	--------	70	Cir. St.	40	St.	s	8	s w	16	s w	20	45	24	--------	--------	------	------
100	Nim.	100	St.	00	--------	----	0	n	6	n	8	35	-11	5 a. m.	6 p. m,	.10	½
00	--------	00	--------	00	--------	n	4	s	2	----	0	6	-10	--------	--------	------	------
20	Cir.Cu.	00	--------	00	--------	s	12	s w	20	s w	16	33	6	--------	--------	------	------
100	St.	100	St.	100	St.	w	2	s w	8	w	12	38	23	--------	--------	------	------
30	Cir.Cu.	00	--------	00	Haze.	----	0	----	0	e	3	41	26	--------	--------	------	------
100	St.	100	Nim.	100	Nim.	s e	6	s e	8	s	7	42	30	2 p. m.	12 m.	.65	------
100	St.	100	St.	100	St.	s w	20	w	28	w	16	35	21	--------	--------	------	------
100	St.	90	Cu. St.	00	--------	w	12	s w	8	----	0	30	15	--------	--------	------	------
60	Cir.Cu.	20	Cu.	30	St.	w	1	s	6	s	6	40	18	--------	--------	------	------
70	St.	20	Cu.	00	--------	s	2	n w	3	----	0	45	27	--------	--------	------	------
30	Cir.Cu.	60	Cu. St.	100	Nim.	e	5	e	8	e	12	45	27	5 p. m.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	20	s w	28	s w	24	42	10	--------	10 p. m.	.75	½
100	Nim.	60	Cu. St.	10	St.	s w	16	s w	24	w	8	12	2	--------	--------	------	------
80	Cu. St.	60	Cu. St.	00	--------	s w	6	n w	12	n w	5	11	-1	--------	--------	------	------
100	St.	80	St.	30	St.	s w	6	s	12	s	5	26	5	--------	--------	------	------
100	St.	60	Cu. St.	100	St.	----	0	s	3	----	0	41	25	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.70	4
74	--------	65	--------	54	--------	----	----	----	----	----	----	29.79	10.07	--------	--------	------	------
		64															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	30	27	30	29	89	100	100	.148	.141	.167	29.231	29.221	29.183	29.212
2	39	42	26	35⅔	100	83	88	.238	.222	.123	28.958	28.962	29.253	29.058
3	15	23	10	16	82	86	79	.070	.106	.054	29.516	29.495	29.533	29.515
4	7	17	13	12⅓	77	67	81	.045	.074	.063	29.529	29.435	29.375	29.446
5	5	17	12	11⅓	100	83	100	.055	.078	.075	29.191	29.122	29.140	29.151
6	6	29	20	18⅓	100	56	70	.055	.087	.075	29.138	29.087	29.151	29.125
7	12	36	25	24⅓	100	45	87	.075	.096	.117	29.154	29.103	29.231	29.163
8	17	40	27	28	100	31	88	.090	.077	.129	29.342	29.376	29.430	29.383
9	27	40	36	34⅓	76	39	61	.111	.097	.129	29.496	29.416	29.331	29.414
10	36	40	41	39	90	82	100	.191	.203	.257	29.186	29.020	28.930	29.045
11	22	28	19	23	72	66	85	.084	.099	.087	29.132	29.185	29.340	29.219
12	9	21	17	15⅔	100	70	67	.065	.075	.063	29.549	29.533	29.491	29.524
13	6	22	13	13⅔	100	71	100	.057	.080	.078	29.472	29.365	29.335	29.391
14	9	31	23	21	100	100	100	.065	.174	.123	29.426	29.428	29.413	29.422
15	24	46	38	36	100	40	38	.129	.125	.091	29.385	29.275	29.118	29.359
16	34	40	30	34⅔	90	56	68	.175	.139	.111	29.118	29.125	29.145	29.129
17	20	30	20	23⅓	70	68	85	.075	.111	.091	29.112	29.102	29.153	29.122
18	21	42	34	32⅓	86	50	70	.096	.134	.138	29.081	29.005	28.960	29.015
19	42	68	52	54	74	38	79	.199	.261	.308	28.830	28.655	28.617	28.701
20	50	35	31	38⅔	93	100	79	.335	.204	.136	28.479	28.587	28.710	28.592
21	30	32	18	26⅔	89	59	84	.148	.106	.082	28.607	28.720	28.837	28.721
22	6	13	6	8⅓	100	62	52	.057	.048	.029	29.043	29.145	29.293	29.160
23	6	22	19	15⅔	76	45	85	.043	.052	.087	29.347	29.293	29.305	29.315
24	8	24	15	15⅔	100	60	82	.062	.073	.070	29.392	29.428	29.456	29.425
25	14	25	23	20⅔	64	75	86	.051	.100	.106	29.412	29.310	29.087	29.236
26	34	38	36	36	90	100	90	.175	.229	.191	28.847	28.700	28.932	28.826
27	32	34	30	32	89	79	89	.162	.155	.148	29.075	29.092	29.057	29.075
28	26	34	31	30⅓	100	70	69	.141	.138	.118	29.042	28.997	29.055	29.031
29	28	43	34	35	88	67	79	.135	.186	.155	29.108	29.052	29.156	29.105
30	32	52	32	38⅔	89	60	100	.162	.232	.181	29.166	28.982	29.176	29.108
31	32	48	35	38⅓	89	49	70	.162	.165	.142	29.257	29.245	29.243	29.248
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	27.03	89	66	81	.118	.131	.120	--------	--------	--------	29.154
*Average						79			.123					

MARCH, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
100	Nim.	100	Nim.	100	Nim.	e	7	e	7	n e	3	39	26	6 a. m.	--------	------	------
100	Nim.	100	Nim.	100	St.	s	5	w	24	w	20	47	15	--------	2 p. m.	.35	------
90	Cu. St.	40	Cu.	00	--------	s w	12	n w	8	w	6	23	4	--------	--------	------	------
100	St.	100	Cu. St.	100	St.	n e	4	n e	8	n e	4	17	5	--------	--------	------	------
30	St.	70	Cu. St.	00	--------	n e	6	n	8	----	0	19	4	--------	--------	------	------
00	--------	50	Cu.	00	--------	n w	6	s w	12	w	4	29	6	--------	--------	------	------
00	--------	20	Cu.	00	--------	w	4	s w	8	w	8	36	15	--------	--------	------	------
00	--------	00	--------	00	--------	w	2	w	8	----	0	41	17	--------	--------	------	------
90	St.	100	Cu. St.	100	St.	s e	8	s e	8	s e	2	41	27	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s e	1	s	2	s w	2	41	22	5 a. m.	11 p. m.	.50	------
80	Cu. St.	40	Cu.	100	St.	n w	20	w	20	w	12	29	8	--------	--------	.03	½
00	--------	50	Cu.	00	--------	n w	5	n w	12	n	8	22	5	--------	--------	------	------
00	--------	00	--------	00	--------	n	12	n w	16	n	12	21	6	--------	--------	------	------
50	Cu.	00	--------	00	--------	n	12	n e	5	w	1	31	9	--------	--------	------	------
10	St.	80	St.	100	St.	w	8	s w	16	s w	12	46	24	--------	--------	------	------
100	St.	70	Cu. St.	50	St.	n w	8	n w	12	n	12	40	20	--------	--------	------	------
100	St.	60	Cu. St.	00	--------	n e	8	e	5	n	3	32	18	--------	--------	------	------
100	St.	30	Cir. Cu.	100	St.	s	7	s	8	s	16	42	21	--------	--------	------	------
100	St.	100	St.	100	Nim.	s	12	s	20	s w	24	69	42	6 p. m.	--------	------	------
100	Nim.	100	Cu. St.	100	St.	s	16	w	16	w	8	50	29	--------	11 a. m.	.15	------
90	Cu. St.	60	Cu.	60	Cu.	w	12	w	20	w	16	32	5	--------	--------	.05	½
50	Cu.	60	Cu. St.	30	Cu.	w	8	w	16	w	8	15	2	--------	--------	------	------
30	Cir. Cu.	90	Cu. St.	60	St.	w	5	s w	5	e	6	22	6	--------	--------	------	------
5	St.	80	Cir. St.	10	St.	e	8	e	6	e	6	24	8	--------	--------	------	------
90	St.	100	Nim.	100	Nim.	e	12	e	12	e	12	34	14	2 p. m.	--------	------	------
100	Nim.	100	Nim.	100	St.	e	4	s	12	s w	8	42	31	--------	3 p. m.	.70	2
100	St.	100	St.	100	St.	w	2	s w	4	n w	4	34	26	--------	--------	------	------
100	Nim.	50	Cu. St.	100	St.	n	2	w	8	w	8	36	24	5 a. m.	10 a. m.	.10	1½
70	St.	60	Cu. St.	30	St.	s w	8	s w	16	----	0	43	28	--------	--------	------	------
100	St.	50	Cu. St.	20	St.	s e	4	w	16	w	12	54	29	--------	--------	------	------
100	St.	20	Cir. St.	00	--------	w	6	w	8	w	3	48	29	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.88	4½
67	--------	64	--------	54	--------	----	----	----	----	----	----	35.45	16.84	--------	--------	------	------
62																	

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1........	35	52	38	41⅔	61	47	91	.127	.183	.208	29.063	28.740	28.750	28.851
2........	34	40	28	34	79	56	77	.155	.139	.117	28.907	29.010	29.141	28.986
3........	25	41	37	34⅓	87	33	71	.117	.184	.157	29.241	29.251	29.272	29.255
4........	31	54	45	43⅓	89	43	61	.155	.181	.182	29.445	29.383	29.235	29.354
5........	45	68	49	54	100	74	78	.300	.509	.272	28.818	28.732	28.982	28.844
6........	37	51	43	43⅔	71	28	51	.157	.104	.142	29.376	29.366	29.358	29.366
7........	36	47	30	37⅔	61	36	78	.129	.112	.130	29.431	29.438	29.475	29.448
8........	30	48	40	39⅓	89	28	73	.148	.133	.182	29.532	29.436	29.436	29.468
9........	38	55	43	45⅓	63	33	92	.144	.144	.254	29.325	29.151	29.028	29.168
10........	48	40	39	42⅓	93	82	82	.310	.203	.195	28.619	28.668	29.017	28.768
11........	37	52	40	43	71	41	65	.157	.159	.160	29.226	29.216	29.291	29.244
12........	30	45	33	36	68	30	70	.111	.087	.131	29.456	29.493	29.491	29.480
13........	31	50	47	42⅔	69	26	77	.118	.094	.249	29.381	29.043	28.913	29.112
14........	39	49	39	42⅓	82	44	64	.195	.152	.152	29.072	29.191	29.233	29.165
15........	36	42	36	38	90	74	90	.191	.199	.191	29.154	28.978	28.950	29.027
16........	34	51	39	41⅓	79	40	55	.155	.149	.131	29.301	29.330	29.385	29.339
17........	34	48	47	43	61	49	62	.120	.165	.202	29.329	29.241	29.065	29.212
18........	38	47	36	40⅓	54	34	80	.123	.112	.170	29.123	29.148	29.143	29.138
19........	38	48	35	40⅓	63	36	80	.144	.120	.162	29.090	29.085	29.122	29.099
20........	35	39	37	37	80	46	45	.162	.110	.103	29.183	29.208	29.178	29.190
21........	35	48	41	41⅓	61	43	65	.127	.143	.169	29.213	29.125	29.135	29.158
22........	35	48	40	41	70	36	48	.142	.120	.118	29.149	29.065	29.087	29.100
23........	35	50	33	39⅓	61	32	61	.127	.117	.113	29.250	29.263	29.378	29.297
24........	32	50	39	40⅓	79	32	55	.143	.117	.131	29.544	29.565	29.535	29.548
25........	40	58	47	48⅓	56	32	48	.139	.153	.156	29.602	29.506	29.461	29.523
26........	48	75	64	63⅓	49	30	48	.165	.256	.285	29.451	29.405	29.385	29.414
27........	61	81	62	68	50	41	72	.269	.417	.399	29.436	29.395	29.398	29.410
28........	57	81	62	66⅔	69	32	61	.322	.335	.340	29.405	29.325	29.288	29.339
29........	66	68	42	58⅔	50	51	66	.316	.349	.177	29.201	29.072	29.072	29.118
30........	37	37	32	35⅓	90	90	100	.199	.199	.181	29.005	28.958	29.012	28.992
Sums....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	44.03	72	43	69	.172	.181	.185	....	....	....	29.202
Averages........................					61			.179			....			

APRIL, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
100	St.	30	Cir.	50	Cir.	e	8	s e	6	n	7	55	29	--------	--------	------	------
00	--------	90	Cu. St.	00	--------	w	12	n w	16	n w	6	44	22	--------	--------	------	------
10	St.	100	St.	100	St.	n e	5	s w	8	----	0	41	25	--------	--------	------	------
00	--------	60	Cir. St.	60	St.	----	0	e	8	e	12	55	31	--------	--------	------	------
100	Nim.	60	Cu. St.	20	Cu. St.	s w	16	s w	12	s w	12	68	35	2 a. m.	9 a. m.	.20	------
00	--------	00	--------	00	--------	w	12	w	28	w	10	51	35	--------	--------	------	------
10	St.	00	--------	00	--------	n w	8	n	12	n	4	48	21	--------	--------	------	------
10	St.	40	Cir.	60	St.	s e	8	e	6	s e	8	48	30	--------	--------	------	------
70	Cir.Cu.	100	St.	100	Nim.	s e	12	e	12	e	12	57	38	6 p. m.	--------	------	------
100	Nim.	100	Cu. St.	100	St.	s w	8	s w	16	n w	16	54	34	--------	6 p. m.	.35	------
80	St.	100	Cu. St.	40	St.	w	12	w	8	w	6	58	27	--------	--------	------	------
00	--------	00	--------	00	--------	n w	12	n w	12	n w	6	45	27	--------	--------	------	------
100	St.	100	Cir.Cu.	30	Nim.	s	12	w	18	w	16	52	37	9 p. m.	11 p. m.	.18	------
100	Cu. St.	80	Cu.	00	--------	n w	8	n w	12	----	0	50	36	--------	--------	------	------
100	Cu. St.	100	St.	100	St.	s	16	s e	12	n e	8	42	32	--------	--------	------	------
10	St.	10	Cu.	00	--------	n e	5	n e	5	n e	6	52	34	--------	--------	------	------
100	Nim.	90	Cu. St.	100	Cu. St.	e	10	s	12	w	16	48	33	7 a. m.	11 a. m.	.05	------
5	Cu. St.	90	Cu. St.	00	--------	w	16	s w	20	----	0	48	30	--------	--------	------	------
100	Hazy.	70	Cu.	70	Cu.	w	8	n w	8	w	8	47	28	--------	--------	------	------
5	Cu.	70	Cu.	10	St.	n w	12	n w	12	n w	2	44	25	--------	--------	------	------
70	Cir.Cu.	100	Cu. St.	100	St.	n w	2	w	8	w	4	52	31	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	St.	e	2	e	6	n e	8	48	32	--------	--------	------	------
50	Cir.Cu.	60	Cu.	00	--------	n	12	n w	12	n	4	51	25	--------	--------	------	------
00	--------	10	Cu.	00	--------	n	6	n w	4	----	0	51	31	--------	--------	------	------
00	--------	10	St.	30	Cir. St.	s	8	s	12	s	8	60	40	--------	--------	------	------
10	St.	20	Cir Cu.	40	Cir. St.	s	12	s w	16	s	8	75	48	--------	--------	------	------
00	--------	20	Cu.	00	--------	s w	8	s w	8	----	0	81	52	--------	--------	------	------
00	--------	00	--------	00	--------	----	0	s w	12	----	0	81	47	--------	--------	------	------
40	Cir.Cu.	70	Cu. St.	50	St.	s w	4	n e	16	n e	10	79	36	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	n e	8	n	8	n	4	37	30	5 a. m.	10 p. m.	.37	¼
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.15	¼
46	--------	59	--------	42	--------	----	----	----	----	----	----	54.07	32.50	--------	--------	------	------
		49															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	33	43	33	36⅓	89	59	89	.168	.164	.168	29.087	29.146	29.185	29.139
2	35	55	45	45	61	32	46	.127	.133	.138	29.301	29.228	29.241	29.257
3	43	64	53	53⅓	59	43	54	.164	.257	.219	29.158	29.010	28.895	29.021
4	55	52	44	50⅓	74	72	84	.321	.270	.241	28.818	28,898	28.942	28.883
5	46	58	46	50	62	47	84	.192	.216	.262	29.083	29.143	29.243	29.156
6	57	70	55	60⅔	69	43	39	.322	.306	.168	29.328	29.316	29.338	29.327
7	45	48	45	46	61	56	76	.182	.189	.228	29.469	29.410	29.315	29.431
8	45	54	54	51	92	93	100	.275	.390	.418	29.100	29.028	28.970	29.033
9	57	62	55	58	87	67	81	.407	.370	.349	28.913	28.930	28.940	28.928
10	54	64	64	60⅔	80	100	68	.405	.596	.403	28.903	28.918	28.823	28.881
11	66	77	64	69	59	46	83	.376	.422	.497	28.863	28.812	28.760	28.812
12	48	43	38	43	78	59	72	.260	.164	.165	28.728	28.905	28.973	28.869
13	35	39	39	37⅔	70	64	73	.142	.152	.173	28.998	29.013	29.042	29.018
14	36	41	37	38	80	57	81	.170	.147	.178	29.000	29.025	29.082	29.036
15	39	54	43	45⅓	82	38	51	.195	.157	.142	29.038	28.955	28.998	28.997
16	41	52	43	45⅓	51	40	51	.142	.149	.142	29.076	29.070	29.123	29.090
17	47	60	44	50⅓	48	29	84	.156	.152	.241	29.197	29.156	29.120	29.154
18	44	48	45	45⅔	84	93	92	.241	.322	.275	28.956	28.830	28.952	28.913
19	40	52	43	45	91	59	84	.225	.221	.231	29.161	29.263	29.293	29.239
20	48	66	53	55⅔	77	39	61	.249	.230	.244	29.379	29.306	29.283	29.323
21	53	71	58	60⅔	60	28	42	.232	.206	.203	29.272	29.168	29.146	29.195
22	57	80	62	66⅓	58	34	46	.268	.349	.256	29.145	29.090	29.082	29.039
23	57	78	61	65⅓	69	29	50	.322	.278	.269	29.068	29.005	28.992	29.020
24	60	71	61	64	77	58	77	.396	.436	.413	29.098	29.047	28.940	29.028
25	58	63	59	60	94	89	100	.452	.510	.500	28.875	28.862	28.890	28.876
26	58	71	61	63⅓	94	57	82	.452	.523	.442	28.972	28.992	28.942	28.969
27	61	70	65	65⅓	82	75	89	.442	.551	.549	28.875	28.742	28.742	28.786
28	63	65	58	62	89	94	94	.510	.583	.452	28.722	28.632	28.765	28.706
29	56	68	60	61⅓	87	60	82	.391	.411	.426	28.938	28.922	28.938	28.933
30	49	65	53	55⅔	57	52	67	.199	.299	.269	29.164	29.098	29.013	29.092
31	50	61	47	52⅔	93	55	77	.335	.297	.249	28.941	28.891	28.911	28.914
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	53.65	75	57	73	.281	.348	.287	--------	--------	--------	29.055
Average						68			.305					

MAY, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
100	Cu. St.	60	Cu.	00	--------	n	4	n e	4	----	0	46	25	--------	--------	------	------
10	St.	20	Cir.Cu.	100	St.	e	6	e	8	s e	1	55	35	--------	--------	------	------
100	St.	30	Cir. St.	30	Cu. St.	e	8	s e	12	s e	12	66	43	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	Nim.	s e	8	s	16	s w	16	62	41	9 a. m.	3 p. m.	.09	------
20	Cu.	5	Cu.	10	St.	w	12	w	12	----	0	59	40	--------	--------	------	------
10	Cu.	20	Cu.	00	--------	w	8	w	8	n	6	71	43	--------	--------	------	------
100	St.	100	Nim.	100	Nim.	e	12	n e	8	n e	6	48	42	11 a. m.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	e	4	e	4	e	2	57	44	--------	--------	------	------
100	Nim.	100	Cu. St.	80	Cir.Cu.	w	2	w	8	s w	1	64	46	--------	9 a. m.	.70	------
80	Cu.	80	Cir.Cu.	00	--------	w	10	s w	8	----	0	68	54	--------	--------	------	------
30	Cu. St.	70	Cu.	100	Cu. St.	s	10	s w	8	----	0	80	47	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	Cu. St.	s w	12	w	12	w	5	52	34	1 a. m.	5 a. m.	1.00	------
100	Nim.	100	Cu. St.	100	St.	w	12	w	16	w	8	40	34	--------	--------	------	------
100	St.	100	St.	50	St.	w	8	w	12	----	0	40	33	--------	--------	------	------
40	Cir.Cu.	100	Cu. St.	00	--------	s e	8	w	12	n w	4	56	29	--------	--------	------	------
00	--------	70	Cu.	00	--------	n w	8	w	20	n w	4	56	29	--------	--------	------	------
80	Cu. St.	90	Cu. St.	100	Cu. St.	s	8	s	16	e	4	61	40	5 p. m.	--------	.04	------
100	Nim.	100	Nim.	100	Nim.	e	4	s e	8	w	5	49	40	--------	5 p. m.	.45	------
100	Nim.	50	Cu.	00	--------	w	12	n w	1	----	0	55	33	--------	--------	------	------
10	St.	10	Cir.	5	St.	w	12	s e	8	----	0	66	40	--------	--------	------	------
10	St.	20	St.	10	Cir.	s	4	e	4	----	0	71	47	--------	--------	------	------
10	St.	00	--------	20	Cir.	s e	4	e	8	s e	4	80	49	--------	--------	------	------
90	St.	80	Cir. St.	70	St.	s e	4	e	4	----	0	78	49	--------	--------	------	------
80	Cir.Cu.	90	Cu. St.	10	Cir.	----	0	e	8	----	0	74	54	--------	--------	------	------
100	Cu. St.	100	Nim.	100	Nim.	e	4	e	6	e	3	64	56	11 a. m.	10 p. m.	.18	------
100	St.	40	Cu.	100	Cu. St.	w	5	n w	4	w	4	71	53	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	Nim.	e	8	s	4	s	4	73	61	9 a. m.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	e	5	e	8	w	12	67	50	--------	10 p. m.	1.00	------
00	--------	90	Cu. St.	50	Cu. St.	n w	7	s w	8	s w	7	70	43	--------	--------	------	------
10	St.	40	Cu.	10	Cu.	e	8	e	12	e	1	64	45	7 a. m.	10 p. m.	.20	------
100	Cu. St.	40	Cu.	70	Cu.	e	8	w	4	w	2	61	39	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	3.66	------
67	--------	68	--------	57	--------	----	----	----	----	----	----	62.06	42.52	--------	--------	------	------
		64															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	63	50	57⅓	88	47	79	.269	.270	.283	28.958	28.868	28.933	28.920
2	50	60	47	52⅓	39	44	85	.139	.229	.273	29.035	29.105	29.174	29.105
3	53	65	52	56⅔	73	43	66	.295	.257	.257	29.226	29.164	29.184	29.191
4	54	70	60	61⅓	67	40	65	.282	.293	.338	29.219	29.238	29.191	29.216
5	61	80	69	70	61	41	70	.325	.417	.496	29.193	29.044	29.065	29.101
6	70	64	53	62⅓	70	58	80	.516	.343	.321	29.065	29.153	29.271	29.163
7	47	65	54	55⅓	85	58	87	.273	.343	.362	29.341	29.308	29.271	29.307
8	54	75	68	65⅔	87	48	65	.362	.415	.443	29.246	29.141	29.092	29.160
9	67	80	71	72⅔	79	55	80	.522	.561	.608	29.015	28.879	28.852	28.915
10	71	66	51	62⅔	80	64	86	.608	.407	.321	28.767	28.792	28.895	28.818
11	51	66	57	58	79	49	63	.296	.301	.295	29.103	29.138	29.161	29.134
12	59	73	65	65⅔	65	35	54	.323	.283	.330	29.192	29.145	29.108	29.148
13	63	75	64	67⅓	67	72	100	.386	.628	.596	29.038	28.947	28.932	28.979
14	67	79	71	72⅓	100	70	90	.662	.691	.682	29.012	28.970	28.975	28.986
15	73	86	71	76⅔	81	51	75	.655	.637	.572	28.962	28.987	29.014	28.988
16	68	87	70	75	84	45	90	.577	.583	.658	29.060	29.052	29.037	29.050
17	71	92	75	79⅓	90	45	90	.682	.680	.785	29.082	29.051	29.054	29.062
18	76	91	75	80⅔	73	50	90	.652	.678	.785	29.069	29.079	29.089	29.079
19	74	88	77	79⅔	76	56	69	.641	.735	.639	29.127	29.093	29.042	29.087
20	70	90	79	79⅔	70	35	62	.516	.478	.612	29.014	28.946	28.904	28.955
21	72	87	72	77	95	62	85	.745	.792	.668	28.909	28.869	28.889	28.889
22	73	85	74	77⅓	85	54	81	.693	.650	.680	28.860	28.859	28.877	28.865
23	69	84	73	75⅓	95	60	85	.671	.677	693	28.914	28.859	28.912	28.895
24	68	82	66	72	90	46	69	.612	.497	.438	28.897	28.917	28.960	28.925
25	64	72	63	66⅓	89	76	89	.529	.595	.510	28.945	28.915	28.937	28.932
26	56	70	65	63⅔	87	61	73	.391	.449	.451	29.018	29.052	29.098	29.056
27	54	67	60	60⅓	80	69	94	.335	.457	.487	29.093	28.998	28.940	29.010
28	57	65	62	61⅓	100	89	77	.466	.549	.429	28.930	28.988	29.122	29.013
29	56	68	60	61⅓	87	74	94	.391	.489	.487	29.206	29.266	29.221	29.231
30	61	82	71	71⅓	94	60	85	.505	.650	.644	29.253	29.180	29.138	29.190
31	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	67.89	81	55	79	.477	.508	.505	--------	--------	--------	29.032
Average						72			.497		--------			

JUNE, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
00	--------	70	Cu.	00	--------	w	8	s w	12	n	4	65	43	2 p. m.	5 p. m.	.18	------
30	Cu.	70	Cu.	00	--------	n	8	n e	5	n	1	60	36	--------	--------	------	------
00	--------	40	Cu.	00	--------	----	0	n	6	w	1	68	40	--------	--------	------	------
00	--------	00	--------	00	--------	----	0	s w	8	s w	8	70	53	--------	--------	------	------
30	Cir.	20	Cir.	00	--------	s	8	s	12	s w	12	80	61	--------	--------	------	------
70	Cir. St.	80	Cu. St.	00	--------	w	16	w	12	n w	2	70	42	--------	--------	------	------
100	Cu. St.	10	St.	60	St.	n e	8	e	6	e	4	65	47	--------	--------	------	------
20	St.	00	--------	00	--------	s e	1	s	4	s	8	76	54	--------	--------	------	------
40	Cir.Cu.	100	Cu. St.	100	Cu. St.	s w	1	s	4	s w	3	81	64	3 p. m.	--------	------	------
30	Cu.	80	Cu. St.	100	Cu. St.	s w	1	w	16	w	16	73	46	--------	3 p. m.	.30	------
90	Cu. St.	10	St.	00	--------	n w	8	e	4	----	0	68	50	--------	--------	------	------
60	Cu.	60	Cir. St.	100	St.	s w	12	s w	12	s	8	74	57	--------	--------	------	------
100	Cu. St.	30	Cu.	100	Cu. St.	s	8	s w	12	w	6	76	59	8 a. m.	10 p. m.	.85	------
30	Cu.	70	Cu. St.	100	St.	s w	8	w	8	w	8	79	68	--------	--------	------	------
10	St.	10	Cu.	00	--------	w	8	w	12	----	0	86	58	--------	--------	------	------
00	--------	20	Cir.	10	Cir.	w	3	s w	4	----	0	87	63	--------	--------	------	------
30	Cir.Cu.	10	Cir.Cu.	30	Cir.	----	0	w	4	----	0	92	67	--------	--------	------	------
50	Cir.Cu.	50	Cir.Cu.	40	Cir.	w	3	e	4	----	0	91	66	--------	--------	------	------
40	Cir.	10	Cu.	30	Cir.	e	3	s e	5	s e	3	91	62	--------	--------	------	------
10	Cir.	50	Cir. St.	100	St.	----	0	s	4	s	4	92	66	--------	--------	------	------
20	St.	20	Cu.	70	St.	s	8	s w	8	s	4	89	68	3 a. m.	4 a. m.	.45	------
5	Cir.	10	Cir. St.	100	St.	s	6	w	8	----	0	86	68	--------	--------	------	------
100	Nim.	50	Cu. St.	100	Nim.	w	2	w	2	w	4	86	65	4 a. m.	10 p. m.	.15	------
10	Cu.	20	Cu.	10	St.	w	4	w	16	w	1	84	62	--------	--------	------	------
100	Cu. St.	90	Cu. St.	10	St.	w	2	s	8	----	0	75	56	8 a. m.	3 p. m.	.33	------
100	Cu. St.	20	Cu.	30	St.	n	3	n	2	e	3	70	50	--------	--------	------	------
100	Cu. St.	100	Nim.	100	Nim.	e	2	e	4	n e	4	70	54	2 p. m.	10 p. m.	.25	------
100	Nim.	100	Cu. St.	100	Cu. St.	n e	2	n	8	n	5	67	54	--------	--------	------	------
100	Cu. St.	60	Cu.	00	--------	n e	3	n e	3	----	0	70	56	--------	--------	------	------
00	--------	20	Cir.	00	--------	s w	6	w	6	w	4	83	59	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	2.51	------
46	--------	43	-- ----	43	--------	----	----	----	----	----	----	77.47	56.40	--------	--------	------	------

44

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	68	76	64	69⅓	60	38	73	.411	.336	.433	29.195	29.208	29.205	29.203
2	62	79	67	69⅓	77	47	74	.429	.465	.489	29.233	29.155	29.148	29.245
3	71	87	77	78⅓	66	55	77	.503	.705	.717	29.151	29.031	29.079	29.087
4	75	86	76	79	77	61	73	.666	.762	.652	29.058	29 069	29.037	29.055
5	72	88	72	77⅓	76	39	71	.595	.504	.559	29 092	29.117	29.134	29.114
6	67	76	73	72	84	73	90	.556	.652	.732	29.175	29.105	29.092	29.124
7	72	83	68	74⅓	90	43	79	.706	.483	.543	29.135	29.107	29.125	29.122
8	58	70	66	64⅔	100	85	95	483	.599	.604	29.185	29.077	29.037	29.100
9	63	66	60	63	94	79	94	.543	.502	.487	29.072	29.095	29.045	29.071
10	61	79	67	69	88	51	79	473	.501	.522	29.080	29.062	29.047	29.063
11	72	87	79	79⅓	80	49	74	.631	.623	.731	28.997	28.906	28.959	28.954
12	62	54	55	57	67	87	93	.370	.362	.405	28.925	28.938	29.050	28.971
13	53	70	55	59⅓	86	52	93	.348	.367	.405	29.125	29.238	29.228	29.197
14	56	75	65	65⅓	87	43	73	.391	.363	.451	29.274	29.245	29.268	29.262
15	63	76	63	67⅓	62	33	78	.356	.287	.446	29.296	29.265	29.243	29.268
16	58	82	67	69	82	33	50	.394	.355	.333	29.256	29.220	29.185	29.220
17	63	81	74	72⅔	78	52	63	.446	.547	.532	29.153	29.052	29.047	29.084
18	68	83	65	72	90	37	89	.612	.410	.549	29.035	29.012	29.042	29.030
19	64	75	62	67	78	52	72	.464	.449	.367	29.092	29.102	29.175	29.123
20	60	78	64	67⅓	82	46	78	.426	.443	.464	29.241	29.240	29.241	29.241
21	65	83	72	73⅓	78	37	71	.483	.410	.559	29.233	29.159	29.148	29.180
22	68	77	65	70	84	69	94	.577	.639	.583	29.105	29.100	29.125	29.110
23	66	87	67	73⅓	95	31	74	.604	.393	.489	29.132	29.087	29.138	29.119
24	62	82	65	69⅔	83	30	68	.460	.322	.420	29.221	29.172	29.203	29.199
25	60	83	68	70⅓	77	37	79	.396	.410	.543	29.251	29.192	29.168	29.204
26	64	69	67	66⅔	100	95	100	.576	.671	.662	29.140	29.090	29.075	29.102
27	65	74	63	67⅓	100	72	89	.618	.604	.510	29.135	29.180	29.203	29.173
28	60	81	69	73⅓	94	45	70	.487	.474	.496	29.251	29.220	29.223	29.231
29	73	86	73	74	63	45	72	.510	.557	.581	29.203	29.179	29.172	29.185
30	70	89	74	74⅓	75	41	81	.551	.556	.680	29.160	29.076	29.037	29.091
31	73	83	78	78	76	67	69	.617	.759	.664	29.052	29.002	29.029	29.028
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	70.53	82	52	79	.505	.500	.536	--------	--------	--------	29.119
Average					71			.514			--------			

JULY, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
10	Cir.	30	Cir.	90	St.	e	4	e	3	e	3	79	58	--------	--------	------	------
10	Cir.Cu.	10	St.	00	--------	se	8	se	8	se	6	80	60	--------	--------	------	------
00	--------	10	Cu.	00	--------	s w	8	s	8	s w	5	90	70	--------	--------	------	------
60	Cu.	50	Cu.	80	Cir.Cu.	s w	8	w	8	w	2	88	67	--------	--------	------	------
30	Cir. St.	10	Cu.	00	--------	n	4	n	5	n	4	88	58	--------	--------	------	------
10	Cir.Cu.	100	Cu. St.	00	--------	se	4	w	6	----	0	80	66	--------	--------	------	------
100	Cu. St.	10	Cu.	10	Cu. St.	e	4	n w	4	n	5	83	54	--------	--------	--- --	------
100	Nim.	100	Cu. St.	100	Cu. St.	s w	2	s	4	e	1	73	57	5 a. m.	8 p. m.	1.40	------
100	Cu. St.	100	Cu. St.	00	--------	n e	1	e	4	n e	3	69	50	-- -----	--------	------	------
00	--------	20	Cu.	10	Cu. St.	n w	2	w	3	w	3	81	60	--------	--------	------	------
00	--------	10	Cir.	90	Cu. St.	s w	2	w	8	w	6	87	60	--------	--------	------	------
100	St.	100	Cu. St.	00	--------	e	1	e	2	e	1	62	47	--------	--------	------	------
40	Cir. St.	40	Cir.Cu.	00	--------	n	3	n e	3	----	0	72	48	--------	--------	------	------
90	St.	50	Cir.Cu.	100	St.	n	1	n e	2	e	1	76	48	--------	--------	------	------
Ha	zy.	00	--------	00	--------	e	2	n e	2	----	0	78	49	--------	--------	------	------
Smo	ky.	00	--------	30	St.	----	0	se	3	e	1	83	58	--------	--------	------	------
90	Cir.Cu.	70	Cir.Cu.	100	St.	e	3	s w	8	w	3	84	62	--------	--------	------	------
100	Cir.Cu.	70	Cu. St.	10	Cu. St.	w	6	w	8	----	0	85	56	4 p. m.	6 p. m.	.10	------
00	--------	80	Cu. St.	00	--------	w	5	w	6	n	2	83	50	--------	--------	------	------
00	--------	20	Cu.	00	--------	n	4	w	5	---	0	81	49	--------	--------	------	------
00	--------	80	Cu. St.	100	St.	w	4	s w	8	----	0	83	63	In nig	ht.	.10	------
00	--------	90	Cu. St.	00	--------	w	8	n	6	----	0	78	58	--------	--------	------	------
10	St.	20	Cu.	20	Cu.	w	2	w	8	n	6	89	48	--------	--------	------	------
00	--------	20	Cu.	00	--------	----	0	w	4	----	0	85	49	----- --	--------	------	------
00	--------	30	Cu.	100	Nim.	n w	4	n w	4	w	3	86	58	8 p. m.	--------	------	------
100	Nim.	100	Nim.	100	Cu. St.	s	2	s	4	----	0	70	62	--------	6 p. m.	.67	------
100	St.	50	Cu.	00	--------	se	2	n e	4	n	2	76	52	--------	--------	------	------
40	Cir.Cu.	80	Cu.	10	St.	n e	2	se	2	----	0	83	57	--------	--------	------	------
10	Cu. St.	30	Cir.Cu.	100	St.	e	2	se	2	s	3	87	63	--------	--------	------	------
50	Cir.Cu.	60	Cu.	20	St.	se	5	w	8	----	0	90	68	--------	--------	------	------
100	Nim.	20	Cu.	100	St.	s w	4	s w	8	e	4	84	53	7 a. m.	10 a. m.	.13	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	2.40	------
43	--------	47	--------	38	--------	----	----	----	----	----	----	81.06	56.71	--------	--------	------	------
43																	

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	78	60	65⅔	70	38	77	.352	.356	.396	29.178	29.175	29.165	29.173
2	63	69	66	66	78	80	89	.446	.564	.570	29.188	29.171	29.087	29.149
3	73	86	75	78	90	65	90	.732	.805	.785	28.997	28.909	28.917	28.941
4	74	83	69	75⅓	90	64	85	.758	.717	.599	28.924	28.917	28.977	28.939
5	68	82	72	74	74	52	80	.509	.572	.631	29.022	28.999	28.967	28.996
6	70	72	72	71⅓	90	90	85	.658	.706	.668	28.955	28.880	28.917	28.917
7	65	75	65	68⅓	94	77	84	.583	.666	.516	29.017	29.007	28.950	28.991
8	67	77	56	66⅔	89	46	75	.591	.422	.336	28.908	28.944	29.092	28.981
9	55	71	57	61	81	41	63	.349	.309	.295	29.218	29.251	29.298	29.256
10	52	70	58	60	86	44	88	.334	.323	.423	29.394	29.396	29.404	29.398
11	59	69	59	62⅓	82	61	88	.410	.430	.439	29.371	29.353	29.348	29.357
12	57	61	53	57	94	82	86	.436	.442	.348	29.316	29.276	29.276	29.289
13	49	73	53	58⅓	93	43	86	.322	.345	.348	29.318	29.251	29.208	29.259
14	55	79	64	66	87	43	89	.376	.430	.529	29.194	29.094	29.107	29.132
15	66	76	70	70⅔	79	73	85	.502	.652	.621	29.085	29.042	29.047	29.058
16	78	87	71	78⅔	73	52	80	.704	.664	.608	29.044	28.999	29.030	29.024
17	72	79	67	72⅔	76	54	84	.595	.537	.556	29.062	29.092	29.145	29.100
18	68	75	56	66⅓	90	44	81	.612	.382	.363	29.176	29.143	29.171	29.163
19	69	82	67	72⅔	61	46	79	.430	.497	.522	29.156	29.120	29.143	29.140
20	69	79	69	72⅓	61	47	70	.430	.465	.496	29.171	29.107	29.045	29.108
21	69	78	62	69⅔	80	61	67	.564	.588	.370	28.875	28.840	29.032	28.916
22	58	68	51	59	64	51	86	.309	.349	.321	29.234	29.246	29.298	29.259
23	51	76	62	63	79	40	67	.296	.350	.370	29.342	29.255	29 238	29.278
24	62	80	65	69	77	37	68	.429	.382	.420	29.204	29.102	29.107	29.138
25	60	86	69	71⅔	77	30	61	.396	.371	.430	29.098	29.082	29.080	29.087
26	72	90	73	78⅓	67	41	76	.524	.582	.617	29.027	29.027	29.082	29.045
27	58	72	56	62	82	49	69	.394	.371	.308	29.265	29.283	29.286	29.245
28	45	77	55	59	100	27	68	.300	.243	.295	29.316	29.195	29.161	29.224
29	56	83	66	68⅓	63	46	79	.282	.520	.502	29.076	29.002	28.975	29.018
30	56	86	68	70	100	48	84	.449	.596	.577	28.988	28.952	28.927	28.956
31	64	63	55	60⅔	89	78	81	.529	.446	.349	28.960	29.020	29.080	29.020
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	67 55	81	53	79	.471	.487	.471	--------	--------	--------	29.103
Average						71			.476					

AUGUST, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
10	Cir.	5	Cir.	00	--------	n	4	n	3	n	1	78	53	--------	--------	------	------
90	Cu. St	100	Nim.	100	St.	n	1	n	12	s e	6	72	61	8 a. m.	9 p. m.	.60	------
100	Cu. St.	70	Cu. St.	100	St.	s w	8	s w	12	s w	4	86	69	12 m.	1 p. m.	.22	------
50	Cu.	50	Cu.	00	--------	s w	4	w	4	n	2	84	57	--------	--------	------	------
00	--------	20	Cu.	80	St.	n	2	n	2	e	4	82	64	--------	--------	------	------
30	Cir.Cu.	100	Nim.	80	Cu. St.	s w	2	s w	12	w	4	82	60	10 a. m.	4 p. m.	.25	------
30	Cir.	100	Nim.	100	St.	w	2	w	6	s e	8	80	61	1 p. m.	4 p. m.	.05	------
100	Cu. St.	20	Cu.	00	--------	s w	8	w	12	w	2	77	46	--------	--------	------	------
00	--------	10	Cu.	00	--------	w	8	s w	12	w	4	71	42	--------	--------	------	------
20	Cir.Cu.	90	Cu. St.	100	St.	w	4	n e	2	n e	1	71	51	--------	--------	------	------
90	Cu. St.	90	Cu. St.	100	Nim.	n e	1	n	4	n e	4	70	54	9 p. m.	5 a. m.	.70	------
100	Cu. St.	100	Cu. St.	00	--------	n	3	n	3	n	1	65	42	--------	--------	------	------
00	--------	20	Cu.	00	--------	----	0	w	4	----	0	75	48	--------	--------	------	------
10	St.	10	Cir.	100	Nim.	w	8	s w	8	s w	1	79	54	7 p. m.	9 p. m.	.05	------
100	Cu. St.	100	Cu St.	----	--------	s w	6	s w	4	----	0	78	65	--------	--------	------	------
70	Cu. St.	50	Cu.	30	Cu.	s w	1	s w	1	s w	1	87	68	--------	--------	------	------
20	Cu. St.	30	Cu.	50	Cir. St.	s w	1	w	1	n w	2	88	62	--------	--------	------	------
30	Cir.Cu.	20	Cir.Cu.	00	--------	n w	2	n w	4	----	0	79	54	--------	--------	------	------
00	--------	30	Cu.	90	Cir. St.	s w	3	s w	3	----	0	84	63	--------	--------	------	------
50	Cir. St.	10	Cir. St.	80	Cir. St.	s e	1	s e	4	----	0	80	65	--------	--------	------	------
90	Cir. St.	100	Cir. St.	90	Cir. St.	s e	1	n	3	n e	2	80	56	--------	--------	------	------
00	--------	00	--------	00	--------	n	4	n	6	----	0	70	38	--------	--------	------	------
10	Cir.Cu.	10	Cir.	00	--------	n	4	w	12	w	8	76	50	--------	--------	------	------
00	--------	00	--------	00	--------	s w	8	w	6	w	4	80	54	--------	--------	------	------
00	--------	00	--------	00	--------	s w	8	s w	12	w	2	87	59	--------	--------	------	------
00	--------	20	Cir.	10	Cir.	s w	12	w	16	n e	2	90	56	--------	--------	------	------
100	St.	00	--------	00	--------	n e	8	n	6	n	1	73	36	--------	--------	------	------
100	Fog.	00	--------	00	--------	n	1	n e	1	----	0	77	43	--------	--------	------	------
30	Cir.Cu.	70	Cir.Cu.	00	--------	s w	6	w	2	w	1	84	52	--------	--------	------	------
100	Fog.	30	Cu.	00	--------	w	1	n w	8	w	1	86	50	--------	--------	------	------
100	Fog.	100	Cu.	00	--------	n	8	n	3	n	1	66	34	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.87	------
44	--------	44	--------	37	--------	----	----	----	----	----	----	78.58	53.94	--------	--------	------	------
		42															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	46	71	56	57⅔	84	36	63	.262	.263	.283	29.138	29.120	29.141	29.133
2	59	77	60	65⅓	65	42	77	.323	.389	.396	29.177	29.245	29.243	29.222
3	55	85	65	68⅓	87	29	58	.376	.350	.359	29.261	29.192	29.122	29.192
4	56	74	54	61⅓	75	63	67	.336	.532	.282	29.058	29.087	29.246	29.127
5	42	68	51	53⅔	100	34	65	.267	.232	.245	29.359	29.369	29.418	29.382
6	41	72	55	56	91	23	50	.235	.179	.218	29.439	29.414	29.401	29.418
7	56	81	63	66⅔	81	45	83	.363	.474	.478	29.339	29.221	29.141	29.234
8	63	81	63	69	94	28	57	.543	.283	.327	29.033	29.002	29.067	29.034
9	63	76	57	65⅓	72	27	69	.416	.243	.322	29.075	29.067	29.100	29.081
10	50	82	68	66⅔	79	26	42	.283	.270	.290	29.181	29.183	29.171	29.178
11	63	88	75	75⅓	57	26	56	.327	.344	.484	29.156	29.150	29.047	29.118
12	57	70	48	58⅓	69	32	78	.322	.234	.236	29.092	29.092	29.196	29.127
13	45	66	47	52⅔	76	32	77	.228	.203	.249	29.256	29.194	29.251	29.234
14	32	74	57	54⅓	100	22	52	.181	.181	.242	29.282	29.206	29.133	29.207
15	53	80	63	65⅓	80	34	89	.321	.349	.510	29.045	28.945	28.912	28.967
16	60	62	56	59⅓	100	83	94	.518	.460	.420	28.762	28.712	28.885	28.786
17	54	63	55	57⅓	87	62	100	.362	.356	.433	28.953	28.985	29.033	28.990
18	56	58	54	56	75	76	100	.336	.365	.418	29.065	29.095	29.133	29.098
19	54	64	52	56⅔	87	58	93	.362	.343	.361	29.159	29.135	29.178	29.154
20	45	67	56	56	100	60	94	.300	.393	.420	29.206	29.181	29.208	29.198
21	48	70	49	55⅔	93	53	93	.310	.385	.322	29.259	29.120	29.201	29.227
22	47	68	56	57	100	60	87	.323	.411	.391	29.338	29.316	29.348	29.331
23	53	67	58	59⅓	93	60	82	.375	.393	.394	29.454	29.421	29.386	29.420
24	45	74	55	58	100	40	87	.300	.331	.376	29.386	29.271	29.236	29.298
25	45	62	55	54	100	88	100	.300	.491	.433	29.005	28.898	28.878	28.927
26	45	52	48	48⅓	92	86	92	.289	.334	.310	28.831	28.673	28.691	28.732
27	48	52	43	47⅔	78	60	92	.260	.232	.254	28.778	29.003	29.156	28.976
28	37	47	40	41⅓	90	70	91	.199	.225	.225	29.217	29.254	29.301	29.257
29	38	50	39	42⅓	91	58	91	.208	.210	.216	29.330	29.284	29.258	29.291
30	47	49	47	47⅔	62	78	92	.202	.272	.298	29.038	28.940	28.728	28.902
Sums	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means	......	......	......	57.76	85	50	79	.318	.324	.340	....	....	....	29.128
Averages	....				71			.327			....			

SEPTEMBER, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
90	Cu. St.	00	--------	00	--------	n e	2	w	6	w	1	62	42	--------	--------	------	------
00	--------	80	Cu.	00	--------	w	3	n w	5	----	0	80	45	--------	--------	------	------
00	--------	40	Cu.	00	--------	e	2	s e	4	s	4	85	51	--------	--------	------	------
00	--------	70	Cu. St.	00	--------	s e	4	w	6	n e	5	76	33	11 a. m.	12 m.	.10	------
00	--------	00	--------	00	--------	n	4	e	5	n e	1	68	35	--------	--------	------	------
00	--------	00	--------	00	--------	n e	3	e	6	e	1	72	41	--------	--------	------	------
60	Cir. St.	20	Cir Cu.	100	St.	s e	7	s e	12	s	8	82	54	In ni	ght.	.11	------
00	--------	10	Cu.	00	--------	s w	8	w	12	w	1	81	47	--------	--------	------	------
00	--------	10	Cu.	00	--------	w	6	w	12	----	0	76	49	--------	--------	------	------
00	--------	10	Cu. St.	60	St.	w	2	s w	5	w	8	82	53	--------	--------	------	------
80	Cu. St.	20	Cu.	80	Cu. St.	s w	6	w	12	s w	8	88	55	--------	--------	------	------
00	--------	60	Cu.	20	St.	w	12	n w	8	n	1	72	34	--------	--------	------	------
00	--------	00	--------	00	--------	n w	1	w	6	----	0	70	32	--------	--------	------	------
100	Fog.	00	--------	00	--------	----	0	s	6	s e	5	74	32	--------	--------	------	------
00	--------	70	Cu. St.	100	Cu.	----	0	s e	12	w	2	80	54	6 p. m.	--------	------	------
100	Cu. St.	90	Cu.	90	Cu.	n w	1	w	12	s	5	62	50	--------	7 p. m.	.96	------
10	Cu.	100	Cu. St.	100	Nim.	s	6	s e	8	s w	4	67	53	7 p. m.	10 p. m.	.10	------
50	Cu.	100	Cu. St.	80	Cu. St.	s w	8	s w	8	s w	4	58	50	3 p. m.	8 p. m.	.20	------
90	Cu. St.	50	Cu.	00	--------	s	6	w	8	----	0	64	42	--------	--------	------	------
100	Fog.	70	Cu.	50	St.	----	0	n w	4	n w	1	70	44	--------	--------	------	------
30	St.	50	Cir.Cu.	100	St.	n w	2	n e	3	e	1	71	42	--------	--------	------	------
100	Fog.	30	Cu.	00	--------	e	1	n e	3	n e	2	68	47	--------	--------	------	------
100	Cu. St.	30	Cu.	00	--------	n e	2	n e	3	n	1	67	44	--------	--------	------	------
100	Fog.	00	--------	00	--------	----	0	s e	5	s e	1	75	43	--------	--------	------	------
00	--------	100	Nim.	100	Nim.	----	0	s	3	n e	5	72	42	1 p. m.	--------	------	------
40	Cir. St.	100	Nim.	30	Cu. St.	w	6	s w	12	s w	6	57	44	--------	7 p. m.	.30	------
90	Cu. St.	100	Cu. St.	40	St.	n w	12	n w	8	w	1	52	32	--------	--------	------	------
100	St.	100	Cu. St.	100	St.	n w	1	w	3	w	2	50	35	--------	--------	------	------
10	St.	80	Cu. St.	30	St.	w	2	n w	2	w	1	52	38	--------	--------	------	------
100	St.	100	Nim.	100	Nim.	s w	1	s w	2	s w	3	56	46	1 p. m.	10 p. m.	.12	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.89	------
45	--------	50	--------	39	--------	----	----	----	----	----	----	69.97	43.63	--------	--------	------	------
45																	

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	53	63	47	54⅓	80	52	77	.363	.455	.249	28.494	28.534	28.702	28.577
2	39	42	36	39	82	50	61	.195	.134	.129	28.931	29.068	29.133	29.041
3	36	40	38	38	61	65	72	.129	.160	.165	29.175	29.177	29.100	29.151
4	42	64	53	53	66	39	67	.177	.177	.269	29.025	28.892	28.918	28.945
5	49	49	43	47	85	100	100	.297	.297	.278	29.008	29.047	29.082	29.046
6	41	57	44	47⅓	91	58	92	.235	.268	.265	29.055	29.008	29.004	29.022
7	47	58	48	51	92	58	93	.298	.282	.310	28.898	28.825	28.912	28.878
8	47	53	36	45⅓	85	54	90	.273	.219	.191	29.025	29.038	29.125	29.063
9	28	51	36	38⅓	100	65	80	.153	.245	.170	29.153	29.141	29.135	29.143
10	28	61	38	42⅓	100	31	81	.153	.164	.186	29.186	29.156	29.128	29.153
11	34	52	45	43⅔	90	47	68	.175	.183	.204	29.103	29.040	28.940	29.028
12	42	45	41	42⅔	100	100	100	.267	.300	.257	28.762	28.685	28.715	28.721
13	43	49	46	46	100	93	92	.278	.322	.286	28.757	28.837	28.997	28.864
14	43	58	48	49⅔	100	48	78	.278	.229	.260	29.150	29.138	29.130	29.139
15	45	48	45	46	92	100	100	.275	.335	.300	29.042	28.938	28.885	28.955
16	45	55	45	48⅓	84	50	68	.251	.218	.204	28.825	28.858	28.907	28.863
17	37	48	45	43⅓	90	70	76	.199	.236	.228	29.110	29.201	29.258	29.190
18	38	48	45	43⅔	91	70	84	.208	.225	.278	29.338	29.185	29.181	29.235
19	50	48	41	46⅓	86	49	57	.309	.165	.147	28.842	28.868	28.920	28.877
20	35	41	36	37⅓	90	57	53	.183	.147	.115	28.990	29.128	29.263	29.127
21	32	38	35	35	69	54	70	.125	.123	.142	29.447	29.431	29.383	29.420
22	35	43	41	39⅔	100	92	91	.204	.254	.235	29.339	29.163	29.087	29.196
23	41	43	40	41⅓	100	92	82	.257	.254	.203	28.992	28.938	28.968	28.966
24	38	56	49	47⅔	81	57	71	.186	.255	.247	29.088	29.078	29.090	29.085
25	41	65	50	52	74	44	93	.190	.272	.335	29.156	29.098	29.083	29.109
26	51	55	53	53	93	93	100	.348	.405	.403	29.045	28.998	28.925	28.989
27	52	62	48	54	100	61	70	.388	.340	.236	28.842	28.875	28.945	28.887
28	41	46	40	42⅓	82	54	73	.212	.169	.182	29.025	29.100	29.163	29.096
29	40	56	36	44	82	40	80	.203	.179	.170	29.025	29.012	29.256	29.098
30	30	52	45	42⅓	100	35	61	.167	.136	.182	29.376	29.284	29.172	29.277
31	53	73	62	62⅔	54	81	46	.219	.655	.256	29.078	29.072	29.112	29.087
Sums														
Means				45.70	87	63	78	.232	.252	.229				29.027
Average					76			.238						

OCTOBER, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
60	St.	80	Cu. St.	100	Cu. St.	s w	5	w	16	n	12	65	39	--------	--------	------	------
100	Cu. St.	90	Cu. St.	100	St.	n	4	n	4	n	3	42	28	--------	--------	------	------
100	St.	100	St.	20	St.	n	1	s w	3	s w	4	42	34	--------	--------	------	------
100	Cu. St.	70	Cu. St.	50	St.	s w	2	s w	12	s w	5	63	42	--------	--------	------	------
100	Cu. St.	100	Nim.	100	Nim.	n e	2	n e	2	n e	3	49	41	1 p. m.	12 p. m.	.40	------
100	Cu. St.	30	Cir.Cu.	00	--------	n e	5	n	4	n	2	58	41	--------	--------	------	------
100	Cu. St.	100	Cu. St.	00	--------	s w	4	n w	5	----	0	58	44	4 p. m.	6 p. m.	.10	------
100	Cu. St.	80	Cu.	20	St.	n	2	n	5	n e	1	58	26	--------	--------	------	------
00	--------	00	--------	00	--------	n	3	n w	6	w	1	51	27	--------	--------	------	------
00	--------	00	--------	10	St.	----	0	w	2	----	0	61	28	--------	--------	------	------
100	St.	100	St.	100	St.	n	1	n e	2	n	3	53	34	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	n	3	n e	4	n e	2	45	41	7 a. m.	--------	------	------
100	Nim.	100	Nim.	90	St.	u	3	u	3	n	2	49	43	--------	3 p. m.	.30	------
100	St.	70	Cu.	100	Cu. St.	n	1	w	4	----	0	58	42	--------	--------	------	------
100	Cu. St.	100	Nim.	100	Nim.	s e	4	s e	3	s w	7	48	43	8 a. m.	10 p. m.	.20	------
70	Cu.	40	Cu.	00	--------	s w	8	s w	20	w	3	56	36	--------	--------	------	------
50	Cir.Cu.	100	Cu. St.	90	Cu.	w	5	w	12	n w	1	48	37	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	Cu.	n	2	s e	8	s e	12	50	38	5 p. m.	--------	------	------
100	Cu. St.	20	Cu.	100	Cu. St.	w	16	w	20	w	12	50	34	--------	5 a. m.	1.34	------
00	--------	100	Cu. St.	100	Cu. St.	w	8	n w	12	n	2	41	30	--------	--------	------	------
100	Cu. St.	100	Cu. St.	100	St.	n	1	n	5	n e	4	38	32	--------	--------	------	------
100	Nim.	100	Nim.	100	Cu. St.	e	6	s e	2	e	1	43	35	7 a. m.	--------	------	------
100	Nim.	100	Nim.	100	Cu. St.	w	4	s w	7	s w	2	43	36	--------	7 p. m.	.11	------
70	Cu. St.	60	Cir.Cu.	00	--------	s w	8	s w	20	s w	12	56	37	--------	--------	------	------
10	St.	00	--------	00	--------	s	5	s e	9	s e	8	65	41	--------	--------	------	------
90	St.	100	Cu. St.	100	Nim.	s e	7	s e	6	s	2	55	51	4 p. m.	--------	------	------
100	Nim.	80	Cu. St.	70	Cu. St.	w	4	s w	4	w	3	62	36	--------	8 p. m.	.55	------
60	Cu. St.	90	Cu. St.	50	St.	s w	5	w	7	n w	4	47	38	--------	--------	------	------
80	St.	20	Cu.	00	--------	w	8	n w	12	n	8	58	30	--------	--------	------	------
70	Cir.Cu.	10	Cir.Cu.	20	St.	----	0	s	8	s w	8	53	30	--------	--------	------	------
60	Cu. St.	10	Cir. St.	100	St.	s w	12	s w	16	s w	8	73	53	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	3.00	------
78	--------	69	--------	62	--------	----	----	----	----	----	----	52.84	37.00	--------	--------	------	------
		70															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	56	74	65	65	63	36	54	.282	.300	.330	29.186	29.143	29.052	29.127
2	64	61	59	61⅓	78	88	88	.464	.473	.439	28.892	28.852	28.982	28.909
3	36	56	39	43⅔	100	40	91	.212	.179	.216	29.102	29.150	29.203	29.152
4	45	62	49	52	76	36	85	.228	.202	.297	29.083	29.075	29.052	29.070
5	49	65	63	59	78	63	100	.272	.389	.576	29.055	28.948	28.850	28.951
6	45	43	38	42	84	75	81	.251	.209	.186	28.952	29.020	29.117	29.030
7	27	46	40	37⅔	88	54	82	.129	.169	.203	29.252	29.243	29.251	29.249
8	38	43	40	40⅓	100	100	100	.229	.278	.267	29.061	28.998	28.992	29.017
9	41	42	41	41⅓	91	91	91	.235	.244	.235	28.911	28.950	28.798	28.886
10	42	43	35	40	74	75	80	.199	.209	.162	28.698	28.612	28.863	28.724
11	35	45	35	38⅓	70	53	80	.142	.160	.162	29.156	29.135	29.171	29.154
12	31	52	37	40	100	41	81	.174	.159	.178	29.239	29.286	29.321	29.282
13	34	56	43	44⅓	79	39	59	.155	.168	.164	29.415	29.344	29.303	29.354
14	43	61	45	49⅔	75	50	84	.209	.269	.251	29.276	29.169	29.133	29.193
15	44	56	38	46	100	75	91	.289	.336	.208	29.005	28.858	28.960	28.941
16	25	36	30	30⅓	100	71	78	.135	.149	.130	29.140	29.106	29.135	29.127
17	22	27	20	23	86	100	100	.101	.147	.108	29.449	29.483	29.548	29.493
18	26	32	32	30	100	100	100	.141	.181	.181	29.442	29.304	29.226	29.324
19	31	40	31	34	100	73	69	.174	.173	.118	29.323	29.391	29.511	29.408
20	16	30	18	21⅓	100	78	100	.090	.130	.098	29.631	29.661	29.648	29.647
21	17	34	20	23⅔	100	70	100	.094	.138	.108	29.592	29.514	29.518	29.541
22	15	38	31	28	100	72	89	.086	.165	.155	29.537	29.561	29.558	29.552
23	25	42	32	33	100	42	79	.135	.113	.143	29.500	29.434	29.418	29.451
24	26	39	35	33⅓	100	64	70	.141	.152	.142	29.400	29.433	29.485	29.439
25	31	41	30	34	89	49	89	.155	.126	.148	29.511	29.448	29.341	29.433
26	30	35	33	32⅔	78	61	89	.130	.127	.168	29.234	29.117	29.057	29.136
27	28	32	30	30	100	79	100	.153	.143	.167	28.985	28.925	28.942	28.951
28	28	35	33	32	100	100	100	.153	.204	.188	28.978	28.922	28.960	28.963
29	33	37	36	35⅓	100	90	100	.188	.199	.212	28.961	28.905	28.933	28.933
30	36	35	30	33⅔	100	70	78	.212	.142	.130	28.953	28.958	29.016	28.976
31	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	38.50	90	69	86	.185	.201	.202	--------	--------	--------	29.167
Average					82			.196			------------------------			

NOVEMBER, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
90	St.	90	Cir. St.	100	St.	s w	7	s w	16	s w	24	72	56	--------	--------	------	-----
100	Nim.	100	Nim.	100	St.	s w	16	s w	12	w	12	64	36	7 a. m.	5 p. m.	.15	------
00	-------	00	--------	10	St.	n w	5	w	12	w	2	56	32	--- ----	--------	------	------
80	St.	90	St.	100	St.	s w	8	s w	12	s w	8	62	45	--------	--------	------	------
90	St.	100	Nim.	100	Nim.	s w	6	s w	4	s w	3	65	45	2 p. m.	12 p. m.	.40	------
100	Cu. St.	100	Cu. St.	00	--------	n w	8	w	16	w	1	43	26	--------	--------	------	------
40	Cu. St.	90	Cu. St.	100	Cu. St.	----	0	e	8	n e	6	46	27	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	e	5	n e	8	n e	12	43	39	1 a. m.	10 p. m.	1.70	------
100	Nim.	100	Cu. St.	100	St.	n e	1	n e	8	n	7	42	40	In night.		.35	------
100	Cu. St.	100	Nim.	100	Cu. St.	s w	8	s w	16	w	20	43	35	11 a. m.	5 p. m.	.10	------
50	St.	30	Cu. St.	00	--------	w	12	s w	12	s w	8	45	30	--------	--------	------	------
00	--------	10	St.	15	St.	----	0	s w	6	s w	2	52	31	--------	--------	------	------
10	St.	10	St.	20	St.	----	0	s w	12	s w	8	56	34	--------	--------	------	------
50	St.	30	Cu. St.	50	St.	s w	6	s w	12	s w	3	61	40	--------	--------	------	------
70	St.	90	Cu. St.	100	St.	s w	4	s w	8	w	16	58	25	--------	--------	------	------
70	St.	30	Cu.	100	Cu. St.	n w	4	w	16	s w	12	36	20	In night.		.05	½
40	St.	30	St.	50	Hazy.	n w	5	w	1	w	1	29	19	--------	--------	------	------
70	Cu. St.	100	Cu.	100	Cu.	e	2	n e	5	----	0	32	26	11 a. m.	--------	------	------
00	--------	00	--------	00	--------	n e	1	n w	4	n	2	41	15	In night.		.25	2½
00	--------	00	--------	00	--------	n	2	n	4	n e	3	30	14	--------	--------	------	------
80	St.	10	St.	00	--------	----	0	n e	1	----	0	36	13	--------	--------	------	------
10	St.	20	Cu.	100	Cu. St.	n	1	n e	2	n e	3	39	15	--------	--------	------	------
00	--------	00	--------	10	St.	e	1	s	1	s	2	42	25	--------	--------	------	------
10	St.	100	St.	100	St.	s	1	n e	5	n e	3	43	26	--------	--------	------	------
10	St.	30	Cu.	10	St.	n	2	e	4	n e	2	42	25	--------	--------	------	------
90	Cu. St.	80	Cu. St.	100	St.	n	1	n	4	n	3	35	27	--------	--------	------	------
100	St.	100	St.	100	Nim.	n w	1	n	4	----	0	32	28	3 p. m.	10 p. m.	.06	¼
100	St.	100	St.	100	St.	n	1	n	2	n	1	35	28	--------	--------	------	------
100	St.	100	St.	100	Nim.	n w	2	n w	6	n w	3	40	33	6 p. m.	--------	------	------
100	Nim.	100	St.	100	St.	n w	2	n w	7	n w	5	39	28	--------	10 a. m.	.06	------
----	--------	----	--------	----	--------	----	----	---	----	----	----	------	------	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	3.12	3¼
59	--------	61	--------	66	--------	----	----	----	----	----	----	45.30	29.43	--------	--------	------	------
		62															

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in Open Air.				Relative Humidity, or Per Cent of Saturation.			Pressure of Vapor in Inches.			Barometer, Reduced to Freezing Point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1........	29	39	29	32⅓	89	64	89	.142	.152	.142	29.083	29.151	29.175	29.136
2........	31	30	30	30⅓	79	89	89	.136	.148	.148	29.143	29.146	29.151	29.147
3........	32	34	30	32	100	79	78	.181	.155	.130	29.087	29.038	29.077	29.067
4........	26	40	32	32⅔	100	82	100	.141	.203	.181	29.007	28.713	28.682	28.801
5........	33	33	30	32	89	89	89	.168	.168	.148	28.672	28.752	29.127	28.850
6........	29	34	29	30⅔	89	79	100	.142	.155	.160	29.240	29.193	29.156	29.196
7........	32	43	32	35⅔	89	59	89	.162	.164	.162	29.017	28.998	29.057	29.024
8........	34	38	35	35⅔	79	81	90	.155	.186	.183	29.065	29.042	29.045	29.051
9........	32	38	33	34⅓	89	72	89	.162	.165	.168	29.133	29.074	29.075	29.094
10........	32	41	32	35	89	74	79	.162	.190	.143	28.998	28.915	28.952	28.955
11........	30	35	25	30	78	61	87	.130	.127	.117	28.962	28.989	29.115	29.089
12........	23	27	26	25⅓	86	64	75	.106	.093	.105	29.085	29.102	29.087	29.071
13........	9	25	16	16⅔	100	75	100	.065	.100	.090	29.223	29.350	29.310	29.294
14........	14	29	26	23	100	89	100	.082	.142	.141	29.498	29.450	29.374	29.441
15.......	29	37	41	35⅔	100	81	49	.160	.178	.126	29.138	29.021	28.958	29.039
16........	40	43	44	42⅓	100	100	100	.248	.278	.289	28.745	28.662	28.634	28.680
17........	30	26	20	25⅓	100	100	100	.167	.141	.108	28.752	28.777	28.845	28.791
18........	16	21	17	18	83	71	83	.074	.080	.078	28.874	28.930	29.037	28.947
19........	13	22	20	18⅓	100	86	85	.078	.101	.091	29.145	29.312	29.325	29.261
20........	25	30	30	28⅓	75	68	68	.100	.111	.111	29.265	29.011	28.951	29.142
21........	19	23	13	18⅓	69	60	81	.071	.073	.063	29.148	29.333	29.445	29.309
22........	15	28	27	23⅓	82	66	76	.070	.099	.111	29.446	29.362	29.148	29.319
23........	31	50	42	41	89	58	66	.155	.210	.177	29.212	29.151	29.169	29.177
24........	39	41	45	41⅔	64	91	84	.152	.235	.251	29.151	29.105	29.095	29.117
25........	46	38	35	37⅔	92	91	90	.286	.208	.196	29.050	29.150	29. 048	29.083
26........	35	50	38	41	90	79	81	.196	.283	.186	28.974	28.602	28.565	28.714
27........	27	33	28	29⅓	76	79	77	.111	.150	.117	28.655	28.733	28.988	28.792
28........	25	29	23	25⅔	75	67	86	.100	.105	.106	29.138	29.181	29.232	29.184
29........	25	28	21	24⅔	87	77	100	.117	.117	.113	29.396	29.401	29.421	29.406
30........	28	36	34	32⅔	77	61	79	.117	.129	.155	29.396	29.306	29.201	29.301
31........	35	31	27	31	90	69	100	.183	.118	.147	29.178	29.211	29.251	29.213
Sums....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	30.39	87	76	86	.139	.154	.143	....	....	....	29.070
Average........................					83			.145			....			

DECEMBER, 1888, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and Snow.			
7. A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Per Cent of Cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning Rain or Snow.	Ending Rain or Snow.	Inches of Rain or Melted Snow.	Depth of Snow, Inches.
95	St.	10	Cu.	10	St.	w	2	w	6	s w	6	40	28	--------	--------	------	------
100	St.	100	St.	100	St.	s w	8	s w	6	s w	2	35	30	--------	--------	------	------
100	St.	100	St.	100	St.	s w	2	s w	12	s w	8	34	25	--------	--------	------	------
30	St.	90	St.	00	--------	s w	6	s w	20	w	8	40	26	--------	--------	------	------
100	St.	100	Nim.	100	Nim.	w	1	n w	8	n e	8	33	28	8 a. m.	9 p. m.	.10	½
100	St.	100	St.	00	--------	n	4	s w	8	s w	8	34	28	--------	--------	------	------
30	St.	70	Cir. St.	70	St.	s w	12	w	8	w	1	44	30	--------	--------	------	------
100	St.	100	St.	100	St.	----	0	s e	2	s	4	38	32	--------	--------	------	------
100	St.	100	St.	00	--------	n e	2	s	5	s w	5	40	30	--------	--------	------	------
100	St.	70	Cir.Cu.	40	Cir.Cu.	s	6	s w	12	w	5	41	30	--------	--------	------	------
10	St.	30	Cu.	90	St.	n w	6	n w	5	n w	5	37	21	--------	--------	------	------
100	St.	100	St.	100	St.	n w	3	n w	8	n w	6	27	9	In	night	.05	½
10	St.	10	Cu.	00	--------	n	2	n w	8	n	5	25	9	--------	--------	------	------
10	St.	20	St.	100	St.	n w	12	s	8	s	4	29	14	--------	--------	------	------
90	St.	100	Nim.	100	Nim.	s	8	s w	16	s	12	40	29	1 p. m.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s	8	s w	8	s w	7	44	30	--------	--------	.50	------
100	Nim.	100	Nim.	100	Nim.	n e	8	n	8	n	7	30	15	--------	--------	.10	------
100	Nim.	90	Cu. St.	70	St.	n	6	n w	5	n w	4	21	12	--------	11 a. m.	------	1
50	St.	50	Cu.	80	St.	n	4	n	3	n	1	25	13	--------	--------	------	------
100	St.	70	St.	100	St.	s w	12	s w	16	s w	20	32	19	--------	--------	------	------
40	Cu.	10	St.	00	--------	n	12	n	8	----	0	24	11	--------	--------	------	------
80	St.	60	Cu. St.	00	--------	s	8	s w	15	s w	12	31	15	--------	--------	------	------
10	St.	40	Cir.Cu.	00	--------	s w	12	s w	12	s	16	52	32	--------	--------	------	------
30	St.	100	Nim.	100	Nim.	s w	12	s w	16	s w	12	47	39	1 p. m.	--------	------	------
100	Nim.	100	St.	100	Nim.	s w	8	w	5	e	1	46	33	--------	--------	.20	------
100	Nim.	100	Nim.	100	St.	e	4	s e	12	s w	24	50	27	--------	5 p. m.	.25	¼
100	Nim.	100	Nim.	80	St.	s w	24	w	20	w	8	33	24	--------	--------	-----	------
100	St.	30	Cir. St.	100	St.	w	12	w	12	w	8	29	22	--------	--------	------	------
100	St.	90	Cu. St.	00	--------	s w	5	s w	6	----	0	28	21	--------	--------	------	------
60	Cir. St.	100	Cu. St.	100	St.	s w	2	s w	4	s w	2	36	28	--------	--------	------	------
100	Nim.	100	Cu. St.	100	St.	w	2	n w	4	w	2	35	22	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.20	2¼
76	--------	75	--------	66	--------	----	----	----	----	----	----	35.48	23.61	--------	--------	------	------
72																	

VI. TILE DRAINING IN RELATION TO FLOOD AND DROUGHT.

The soil supply of water for crops is so intimately related to plant growth that any cause capable of seriously disturbing the supply of soil water through the growing season should be regarded with concern. The condition of the water in the soil has an important bearing on the subject. Water held by capillarity in the soil is better suited to supply the plant than free water, which will flow under the action of gravity.

Drainage may have for its object the removal of surface water of ponds and marshes (ditches), or the removal of excess of water in the soil (tile draining). The removal of stagnant surface water from marshes and bogs by ditching is sanctioned by the great mass of intelligent farmers; to replace a foul swamp by a rich meadow meets with just approval. Not only is the useful area of the farm increased, but the general health is promoted. By the government surveys about one-ninth of the lower peninsula of Michigan was returned as swamp land. By a system of county and town drainage provided by State law, and by appropriations of swamp lands for extended systems of drainage, these swamp lands have been reclaimed in large portions of our State, and with such manifest benefit to the public health that three-fourths of the malarial diseases that prevailed in our State prior to such swamp drainage have been driven from our borders. The benefit, both to the farmer and the people at large, is so pronounced that a proposition to return these rich meadows to reeking swamps, with the attendant fevers and suffering, would receive small encouragement from any class. Our people prefer the harvest gathered by a Buckeye reaper, rather than that of the skeleton reaper with his invisible scythe.

Yet the gain from this system of surface drainage is not an unmixed good. Every deviation from nature's plan seems to bring in its train retribution in some form. The ready and rapid flow of surface water by open ditches augments the flood at times of thaw or heavy rains; and, by diminishing the area of evaporation, makes the air more arid in times of drought. These results are inseparable from free drainage by open ditches. So far as I have observed the open ditches make the floods more severe, they come more suddenly, rise higher and subside quicker than in the olden time before the swamps were drained, and while the face of the country was mostly covered with forests. These alternations of flood and drought are the joint results of ditching and deforesting. Yet the good secured so far overbalances the incident evil that no return to the primeval condition is to be expected in our State. We simply accept the fugitive evil as the price for the permanent good.

Some writers in the agricultural press aver that tile draining increases the evils of open-ditch drainage, that "the 95,000 miles of tile drains in Illinois, and perhaps a third as much in length of open ditches, together with a proportionate measure of both in Iowa and Indiana, have reduced these States to the natural condition of Kansas by removal of all surplus surface water, * * * affording creeks dry beds six months in the year, lowering the well water level twenty feet in twenty-five years, partially suppressing the origin of summer thunderstorms, and, in short, changing the climate and surface aspect of the country in course of settlement dating back not more than 50 years quite as much as 500 years of similar excesses have done for the middle and south of Europe."

This is not a cheerful picture. How far tile draining has contributed to such results demands thoughtful consideration. I cannot speak from personal knowledge of the conditions relating to soil water in the States named, but an intimate acquaintance with the country around the Michigan State Agricultural College for twenty-five years, during which time a large amount of tile drains have been laid and many swamps ditched, enables me to say that no such depression of the well water level has taken place in my neighborhood, and that the well water level has remained essentially the same during the whole period. I have not been able to learn of any such marked lowering of the water table in other portions of our State.

Ex-Governor Porter, of Indiana, in addressing the American Public Health Association in 1882, said: "It gives me pleasure also to say that the practice of underdraining the soil has in this State been found so greatly to increase its productiveness that, in proportion to the area of the State, it is said we have more underdrained soil than any of the States. Underdrainage has everywhere been followed by a great lessening of sickness; and intermittent fever, once so common, has become so rare that it is a good deal less prevalent than in some of the oldest States."

The general proposition that tile draining increases flood and aggravates drought, demands careful consideration.

Flood.

The common time of special danger from flood in the level States at the north is when the accumulated snows of winter rapidly thaw, especially with warm rain, and while the ground is still frozen and thus impervious to the accumulating water. The depth of frozen soil varies widely in the same neighborhood. On the 18th of February, 1888, when the ground was, for the most part, covered with snow which was rapidly melting, I explored the soil by boring with a long-shanked auger to determine how deeply the soil remained frozen. The passage from frozen to free soil was almost as marked as when boring through a plank. In a porous sandy soil which had been covered with snow all winter, and was still covered with two inches of snow, the ground was frozen 19 inches; in a clay soil near by, which had been blown bare of snow repeatedly and was still uncovered, the frozen soil was 24 inches deep; in a sheltered garden where 10 inches of snow still remained, the frozen soil was 8 inches; in a forest where snow was not drifted by the wind, and the covering of snow and forest leaves remained undisturbed, the frost line averaged 2 inches, while in an open field in the lee of the forest the frost line extended 15 inches. These measurements were all taken the same day.

When the surface soil is impervious to water it is manifestly a matter of indifference, so far as water is concerned, whether the subsoil is tiled or not. The surface water cannot reach the tile drain, and no flood flow of water can come from such tile drains. Yet we find our worst floods with a frozen surface soil. The water can only flow over the surface, and with a deforested country there is little to obstruct such flow, and the danger of flood is great.

But in the warmer seasons of the year we occasionally have very heavy rainfalls and disastrous floods as the result. Do tile drains increase these floods?

The action of a tile drain may be continuous or intermittent; when continuous it is usually the discharge of some spring; when intermittent it is the usual action of a drain in carrying off the excess of rainfall beyond what the soil can hold as capillary water, or else the redundant accumulation of soil-water by the indirect action of frost. How long will it take water to percolate through three feet of soil to reach an ordinary tile drain? The time required will depend upon the kind and porosity of the soil, and upon the amount of water already in the soil. If the soil is saturated with water, the addition of water at the top will cause almost immediate flow at the bottom, but none will flow till the soil contains all the water it can hold by capillary action.

Not having at hand the desired data in regard to the passage of water through soil, I made some investigations on this subject, and was fortunate to have the means at hand to verify certain points by means of a large balance made for the Experiment Station by Becker Brothers, of New York. By actual trial, I find that when this balance is loaded with 5,000 grammes in each scale-pan, the balance will turn with one-tenth of a milligramme. A balance that will turn with one fifty-millionth of its load is sufficiently delicate for such investigations.

A number of tin tubes 2 inches in diameter and 20 inches long, part of them closed water-tight at one end, and others closed at one end by perforated tin, were used for the experiment. The tubes were carefully weighed and marked; then filled with sifted air-dry soil, and again weighed; then placed in a vertical position and water added till water began to flow from the perforated end of the tube, when the time was noted that was required for percolation, and when the flood ceased the tubes were again weighed. This gave data for the weight of dry soil, the time for percolation of water through 18 inches of dry soil, and the weight of water taken up by dry soil and held by capillary attraction. The tubes with closed ends gave similar data, except that the time of percolation could not be so accurately determined.

Two kinds of soil were used, a garden soil of sandy loam, and road dust, with considerable clay. The tubes were used in duplicate with both kinds of soil. The weight of the dry garden soil as compared with water, volume for volume, was 148 to 100; that of the road dust was 173 to 100.

In the perforated tubes with garden soil (air dry), the vertical column of water required to thoroughly wet 36 inches of soil was 12½ inches, and the time required was 20 hours, and the water retained in the capillary condition was 23.47 per cent of the weight of the soil. With the road dust the time required to thoroughly wet the road dust was 24 hours, and the water held by capillary action was 18.25 per cent of dry soil. It was difficult to determine the exact time when the water reached the bottom of the closed tubes, but as far as could be discovered the time was about two hours longer than in the perforated tube, the air enclosed in the tube escaping only by bubbling up through the water, while in the perforated tube it had free escape at the bottom. That this soil in closed tubes held free water soon after it had all sunk away from the surface was shown by the fact that the percentage of water was increased from 23.47 per cent to 26 per cent.

Percolation in Damp Soils.

The time required for water to flow through air-dry soil, and the quantity required to wet them is hardly a fair test, because we never find 35 inches depth of such dry soils in lands used for farming in this climate. After the soil in these tubes had been thoroughly wet, the tubes were left freely exposed to the air in a room, well ventilated, for 33 days of hot and drying weather. Evaporation could only take place at the top of the closed tubes, representing a soil where only surface evaporation is possible, while evaporation could freely take place in the perforated tubes from both top and bottom, representing in an exaggerated degree a tiled field.

At the close of this "drought" of 33 days the tubes were again weighed to determine the loss of water by evaporation and the amount still retained in the soil. The following table exhibits the results:

Loss by Evaporation from Drained and Undrained Soils.

Air Dry Soil in	Average Weight of Water Retained by Soil.		Evaporation. Grammes.
	At Beginning of 33 Days' Drought. Grammes.	At End of 33 Days' Drought. Grammes.	
Open tubes	323.43	223.76	99.67
Closed tubes	358.15	288.80	69.35

On drenching these soils it was found that the moist garden soils in perforated tubes required 4.45 inches in vertical column of water to saturate them, and the average time for water to percolate through 36 inches of this moist soil was 9½ hours; while the soils in the closed tubes required for saturation a vertical column of 2.35 inches, and 11 hours time. It will be noted that soils in the closed tubes required only about half as much water to wet them down as the soils in the perforated tubes, though it required a longer time. The rapidity with which a drained soil takes up the rain when it falls after a dry spell is not to be overlooked in discussing tile-draining. This singular fact came out in these experiments that at the second wetting of these soils after 33 days of dry weather as regards the soil in the tubes, the drained soils absorbed and retained by capillary action an average of 34.47 grammes (or .67 inch vertical column) more water than at the first wetting of the air-dry soil, while the soils in the closed tubes could not take up as much water by capillary action as at the first wetting, the loss of capillary power being 8.57 grammes (.17 inch vertical column of water). It thus appears in this experiment that the underdrained soil has an increase of 12.6 per cent of capillary power over the soil destitute of drainage. The draining and the non-draining of the soils in these experimental tubes are both in exaggerated form. But even if we estimate this increase of absorptive power in a tile-drained field at only one-third of the amount found in these tube experiments, this will enable the tiled field to take up and retain after a dry spell, one-fifth of an inch of rainfall more than the field destitute of drainage, in case of copious rainfall that comes in a short period. Any of you who have measured rainfalls will know that .22 inch of rain is a very respectable shower. This increased water-holding power of tile-drained soils is of great importance, and is not to be overlooked in discussing the effects of tile-draining. The influence of draining is often regarded simply as removing water; but the secondary influence upon the soil, even if the tile is dry for half the year, is of equal importance with water removal. The conservative influence of underdraining by this increased capacity to hold water when it suddenly comes and is in danger of running off by surface flow, is one of the benefits to be considered.

Some have attempted to explain the fact that a tile-drained field will endure drought better than one not drained, by claiming that the air circulating through the tiles gives up moisture to the soil, but I think a better explanation is the increased power of the drained soil to hold water in capillary form, and perhaps also from its greater power to draw up water from the deeper soil by capillary action.

Time of Flow of Field Drains.

Such observations as I have been able to make on the time of beginning of the flow of water in tile drains after the commencement of a storm conforms in some degree to the results of experiments already given. Except when the ground is fully saturated with water, as in the thaw of spring, when the water accumulated by the action of frost is rapidly set free, there is a sensible interval of time after the rain begins to fall before the tile-flow sets in. In many rains the tiles do not discharge at all in summer because the increased capacity to hold water enables the soil to absorb all the rain. In the majority of cases when the tiles give a flow it is only after 12 to 24 hours—in most cases about 16—after the storm has begun. By the time the tiles begin to discharge the storm usually begins to break away, and the action of the tile is to prevent flood, instead of augmenting it. Where a flood is caused by excessive rainfall or a "cloud-burst," the flood is caused by the water flowing over the ground and not through it. The great floods that have devastated portions of our country have occurred in regions where tile-draining is almost unknown. Take the floods in West Virginia and around Pittsburg as examples. Some of you may recall the dreadful flood that swept Alleghany City in July, 1874. I visited the scene a few days after and while the marks of the destroyer were not effaced. A sudden and very heavy rain had fallen on the neighboring hills, the water by converging valleys was poured upon the city, the nine foot sewer became obstructed, and the water rose 25 feet in the streets in as many minutes, and the destruction of life and property was awful. Yet in all the track of that storm there were not two miles of tile drains, and if there had been a hundred miles the flood would not have increased in violence thereby.

I think the opponents of tile draining will find some difficulty in pointing out regions where tile draining has been extensively carried on, where destructive floods are especially injurious, and to find other localities similarly situated, except in the matter of tile draining, where floods are never known.

Conclusions.

From these investigations I arrive at these conclusions:

1. Surface ditching in conjunction with deforesting may increase floods and contribute to droughts.

2. Tile draining may increase flood at the "break-up" in spring when the water accumulated in the surface soil by the joint action of frost and soil capillarity during the winter, and the surface accumulations in the form of snow are suddenly set free by a rapid thaw.

3. During the warm months tile draining tends to mitigate flood by taking up the excessive rainfall and holding it in a capillary form, keeping back the sudden flow that would pass over the surface of the soil if not absorbed by it, and escape by flood; and mitigating summer drought by increased capacity of the soil to hold water in capillary form, and to draw upon the subsoil water supply by reason of the increased capillary power of such soil produced by tile draining.

VII. ENSILAGE.

The subject of ensilage has assumed such importance both with the farmer and the stock-grower, that anything connected with it will command their attention. So much Indian corn is raised for this purpose that it is a matter of interest to know at what period of growth to cut the corn so as to get the best results in the silo, and also to find the relative composition and food value of the stalks cut at any given time, and the ensilage made from the same.

An investigation bearing on this subject was undertaken in 1888, and the results, as far as anything decisive was reached, were given in Bulletin No. 49. But this work was not satisfactory, mainly because the untimely frost put a stop to the work before the field of corn assigned for the experiment had reached such maturity as the investigation contemplated, viz.: from tasseling of the corn to complete ripeness of the grain. It was therefore decided to repeat the experiment in 1889, following essentially the same plan as in 1888. The experiment began on the 10th day of August, the corn on a measured plat of ground being cut, weighed carefully, a portion being reserved to determine the amount of solid matter per acre, and for analysis, and the rest placed in a small silo. This was repeated at periods of about six days till the corn stalks were fully ripe, seven specimens of fodder and ensilage having been secured in this way. When the ensilage is ripe, the material will be analyzed and the results of both sets of analysis—of the corn stalks and of the ensilage—will be given in a future bulletin. The excessive drought of this season will disturb the investigation to some degree, but it is hoped the results will yet be of real value to the farmer and stock feeder.

VIII. MISCELLANEOUS ANALYSES.

A variety of materials come to this department for analysis, and the results of such investigations are often of interest, and sometimes of profit to our people.

Marsh Grass.

Persons in different parts of the State have requested information in regard to the fodder value of the "marsh grasses" that grow so abundantly in some parts of our State. A very good specimen of this marsh hay was obtained for analysis. The grass was cut in good season and before the development of a strong silicious covering, or dense woody fibre. Hon. A. C. Glidden, who furnished the hay, says that it was relished by sheep, who kept in good condition with the marsh hay as principal food. The marsh hay, as received, gave the following results on analysis:

Water, per cent	7.86
Ash	4.20
Crude fibre (woody)	27.55
Albuminoids (crude protein)	7.00
Ether extract (fat, etc.)	3.60
Carbohydrates (nitrogen free extract)	49.79
	100.

These analytical results of marsh hay compare very favorably with those of timothy hay. There is little doubt but that many kinds of the so-called swamp grasses, if cut at the proper season and properly cured, will furnish very valuable fodder. The proportion of digestible matter is larger than commonly supposed.

Reindeer Moss.

As a mere curiosity to our people, the analysis of reindeer moss is here presented. The moss grows in only a few localities in our State, and is probably not used by any animals in our State. The specimen analyzed was found at Port Sandfield, in the Muskoka region of Canada. Its appearance was so unpromising as a fodder that some of it was brought home for analysis, which gave the following surprising results:

Moisture (driven off at boiling heat)	14.25
Dry matter	85.75
	100.

The dry matter gave the following:

Crude fibre (woody matter) per cent	17.95
Ash	1.29
Crude protein (albuminoids)	4.10
Ether extract (fat, etc.)	2.11
Carbohydrates (nitrogen free extract)	74.55
	100.

The proportion of albuminoids is small, but the digestible carbohydrates belonging to the starch and gum class are relatively large.

Wheat Screenings.

The value of immature grains, screenings, etc., does not seem to be properly recognized. Shrunken and imperfect grains that give little promise of valuable results in milling, are usually regarded as equally valueless for cattle food. The nitrogenous portions of food are the most costly and most valuable in animal food. Their most valuable quality, aside from direct food value, is the fact that they enable the animal to digest and assimilate a larger amount of the coarser carbonaceous foods that would fail to be appropriated by the animal in the absence of a sufficient supply of nitrogenous food or albuminoids.

In an extended investigation into the composition of wheat cut at different periods of ripening, made in this laboratory in 1880, published in the report of the State Board of Agriculture in 1881 and in volume IX. of the census of the United States for 1880, it was shown that the relative proportion of nitrogenous materials in wheat was much larger in the early period of growth of the kernel, and rapidly fell off as the period of complete ripening came forward. A part of this nitrogenous material was in the form of amides, the food value of which is not well settled, though all writers concede that they are valuable; still the value of a given weight of such immature grain as compared with the same weight of the same grain at complete ripening was much larger.

Mr. G. S. Pearson, of Kalamazoo, sent two samples of wheat screenings to be analyzed in order to determine their value for stock food. The screenings consisted largely of shrunken and immature grains of wheat, some broken kernels, chess, seeds of weeds, chaff, etc.

Analysis of Wheat Screenings.

	No. 1.	No. 2.
Water	7.80	8.40
Ash	3.80	3.76
Crude fibre (woody matter)	4.95	6.10
Albuminoids	12.53	13.38
Amides	2.25	1.68
Ether extract (fat, etc.)	2.65	3.03
Carbohydrates (starch, gum, sugar, etc.)	66.02	63.65
	100.00	100.00

Wheat Bran, Etc.

Specimens of feeding stuff were received from Geo. L. Sheldon, of Climax, for analysis. No. 1 was described as "a sample of bran, or rather it is the germ of the wheat separated from the rest, and reground." No. 2 is wheat bran. Mr. Sheldon says No. 1 is "generally run into coarse middlings, and sold as such. Almost any roller mill can separate it out. I can buy it for

$11 a ton, bran the same, and fine middlings at $14." The analysis is given as affording information concerning the coarse products of roller mills:

	No. 1.	No. 2.
Water	12.76	8.96
Dry matter	89.24	91.04
Composition of Dry Matter:	100.00	100.00
Ash	6.74	6.83
Crude fibre (woody matter)	8.94	8.51
Albuminoids	17.55	17.30
Ether extract (fat, etc.)	4.80	5.16
Carbohydrates (starch, sugar, etc.)	61.97	62.20
	100.00	100.00

These materials, in the dry form, agree closely in composition.

Sugar Beets.

The project of raising sugar beets on the "stump lands" from which the pine timber has been removed, has often been brought to our attention, but no one has made trial on a sufficient scale till this year. A short time ago the following letter was received relating to this subject:

TAWAS CITY, *Oct. 14, 1889.*

Prof. Kedzie:

DEAR SIR—Some of my countrymen have been experimenting with German sugar beets and have requested me to ask you if you would analyze the beets and find the percentage of sugar they contain. They believe that this northern country is well adapted to growing sugar beets, and if so it would be a great benefit to the farmers here. The specimens grown are very good, especially for the season past, and if you could analyze them and be reasonably sure that it would pay, more would be planted and efforts made towards starting a sugar factory. Hoping that you will take interest in the matter as you always have in anything that would be a benefit to the public, I remain

Yours respectfully,

GEO. C. ANSCHUETZ.

A reply was immediately sent back that the analysis would be made, since the Experiment Station was established for such work, and asking for full information in regard to the kind of soil, method of cultivating, and the product to the acre. A parcel of beets and the following letter soon came to hand:

TAWAS CITY, *Oct. 23, 1889.*

R. C. Kedzie, Chemist of Experiment Station:

DEAR SIR—Yours of the 16th inst. at hand, and in reply will say that we will send by express a package of one lot of German sugar beets—seed imported from Germany—and one lot of American sugar beets, each lot properly labeled.

In answer to how they were grown and on what kind of soil, I would say that the American sugar beet was grown on red clay, planted on pine stump land that had never been cultivated or manured. Before the seed was planted the ground was hoed, and after the beets came up they were hoed to keep the weeds down; that was all the cultivation they received.

The German sugar beet was grown on sand with clay subsoil two feet below the surface. The ground had been plowed four times—once in each season; no manure used, nor had it been manured previously.

The selection sent is of medium size; larger and smaller specimens were grown on the same soil. The smallest would contain more sugar than mediums or larger: that is why mediums were chosen.

I also give you an outline of how they are grown in Germany and on what principles a sugar plant is run.

1. The ground on which sugar beets are grown in Germany is sandy, or high clay land. Low land is not used for growing the beet. It is claimed that on low land the beets grow larger, but contain less sugar. The year before the beets are grown the land is heavily manured with stable manure and a crop of barley or other grain taken off. The ground is then very deeply plowed and seeds sown in drills 14 inches apart, and plants thinned to 14 inches in a row, and hoed about three times during the season. If the beets tend to grow out of the ground they are covered to the leaves. (You will find the specimens sent are trimmed of all that grew above the ground. All the portion trimmed off is of no use to the sugar manufacturer, and is fed to cattle by the grower.)

2. The sugar plant in Germany is mostly owned by the farmers and run on the same principle as a bank or other organization, each stockholder agreeing to grow a certain amount of beets, delivering them in the fall to the factory and receiving so much a ton for his beets. All the refuse of his beets is returned to him and used for fertilizers, and no other fertilizers are allowed. Any stockholder using fertilizers or freshly manured ground is subject to a fine of $50, and for a second offense he is expelled from the organization. Beets are grown every three years on the same ground, and an acre will average about ten tons.

This information is from parties that have grown the beet in Germany and worked in the plant. They believe that the beet can be successfully grown here, and if so, it would be a great benefit to this part of Michigan. We have a good harbor and railroads, and plaster which is used in cleaning the sugar. * * * * Any farther information as far as I can obtain it will be cheerfully given.

Respectfully yours,

GEO. C. ANSCHUETZ.

The roots, as received, were well developed and fair in appearance. A quantity of each kind was cut into very thin slices, weighed and then dried to constant weight in an air-bath at 212° F., and the weight of original substance, the loss by drying and the weight of dry residue, the per cent of dry matter and of water was determined. Each kind of beet was grated to a fine pulp, and the juice extracted by a filter press; the specific gravity of the juice taken, the quantity of sugar in the juice estimated by the saccharometer to give the *apparent* sugar present, and then the clarified juice tested for glucose by Fehling's test, and finally the sugar in the juice estimated by polarized light. The following table gives the results of such examination.

	German Sugar Beet.	American Sugar Beet.
Average weight of beets, in ounces	21	16
Total solids on evaporation, per cent	19.00	22.7
Water, loss by evaporation, per cent	81.00	77.3
Specific gravity of the juice	107.26	108.24
Apparent per cent of sugar by saccharometer	15.10	18.20
Glucose, by Fehling's test	traces	traces
Cane sugar in juice by polarization	14.14	15.22
Cane sugar in whole beet, per cent	12.78	13.40

Beets that contain 12 to 13 per cent of crystalizable sugar are worthy of consideration and compare favorably with German and French sugar beets. While sugar beets require a soil of good quality for full development, it may be found that much of the land from which the pine has been removed for lumber will afford good crops of beets. The sandy soil would probably furnish roots rich in sugar. The ease with which such crop could be raised on this sandy soil, and the ability of the beet to withstand frost and drought make this crop an interesting if not a promising one for many districts in our State. There is no question about the value of these beets for feeding stock.

ANALYSIS OF SUGAR BEETS FROM OTHER LOCALITIES.

Five specimens of sugar beets grown the past season were sent to me for analysis by Hon. E. W. Cottrell—three from the farm of Hon. T. W. Palmer. The results of analyses are presented to show the capacity of beets grown in this State to produce sugar and that the climate is suited to the formation of sugar.

No. 1—Seed imported from Germany, a cross of vilurorin and imperial beets, per cent sugar, 14.58.

No. 2—Sugar beets, grown without manure, per cent sugar, 11.40.

No. 3—Manured with 200 pounds superphosphates and 200 pounds nitrate of soda per acre, per cent sugar, 11.40.

No. 4—Beets raised by Mr. Klein of Oakland county, per cent sugar, 12.12.

No. 5—Beets raised in Livingston county, per cent sugar, 7.86.

All of these beets except No. 5 contain sugar in quantity that would pay for manufacturing purposes. A beautiful specimen of sugar was made from No. 2 of this series, and can be seen in the Museum of the Chemical Laboratory.

In carrying out these analyses, and in the laboratory work in this department, I am under great obligations to my faithful assistant, Mr. Geo. L. Teller.

Respectfully submitted,
R. C. KEDZIE,
Chemist of Experiment Station.

REPORT OF THE ENTOMOLOGICAL DEPARTMENT.

President O. Clute, Director Experiment Station:

DEAR SIR—I submit the following report of the work done in the Entomological and Apiarian Departments of the Experiment Station for the year ending June 30, 1889:

At the beginning of the season I submitted the following scheme of work for the year, which was accepted by the "advisory board" of the station:

"In the Entomological Department, experiments with the arsenites in hopes to find what substance is least injurious to foliage, and what may be the influence of date of application and atmospheric conditions on the amount of injury wrought; to continue the experiments with the arsenites and carbolized plaster as remedies for the plum curculio; to carefully investigate the matter of pasturing or feeding grass growing under trees at the time they are sprayed with the arsenites, London purple or Paris green, that we may know positively the danger incurred in such practices; to investigate the ravages of the several flea beetles; Haltica Chalybea Ill., Crepidodera Cucumeris Harr., and Phyllotreta vittata Fab., and if possible find a satisfactory remedy for each and all; to investigate the matter of growing potatoes, to determine what relation there may be between insect attack and scab; and to give attention to such other insects as may from their numbers or ravages give cause for anxiety or alarm.

"In the apiarian division of our work it was proposed to experiment with the following honey plants: Rocky Mountain bee plant (*Cleome integrifolia*) Chapman honey plant (*Echinops sphærocephalus*), and a species of Melissa; to determine the wisdom or unwisdom of special planting of all or any of these plants solely for bees; to again sow the Japanese buckwheat, to further study its prolificness, its value as a honey plant, and its power to resist drought, and to mature a good quality of seed even though sown early or late; to continue our careful cross-breeding of bees; to arrange for analyses of various kinds of honey; and to investigate and observe such matters of practical manipulation and management as may be suggested during the season."

EXPERIMENTS WITH THE ARSENITES.

Quite elaborate experiments were performed with London purple, Paris green and common white arsenic. The details of these experiments, together with the results, were embodied in a paper read before the "Society for the

Promotion of Agricultural Science" at the Toronto meeting, and printed and distributed as Bulletin 53 of this Station. So important are the conclusions deduced from these experiments that I will briefly state them here:

First—Early spraying seems less harmful to foliage than does later. Spraying in May rarely does harm, while the same in June or July, even with a more dilute application, is often a serious damage.

Second—There seems to be no essential difference as to the time of day. Spraying early in the morning, at noontide, or towards night-fall, each seemed about as the others, as to injury produced on the foliage.

Third—A rain soon after spraying increases the damage to the foliage, especially if we use London purple or white arsenic.

Fourth—London purple is more injurious to tender or susceptible foliage than is Paris green, while white arsenic is more injurious than is London purple.

Fifth—White arsenic should never be used in such warfare. London purple may be used on all trees, except the peach, early in the season, in May, but never stronger than one pound to two hundred gallons of water. If used on shade trees or on plum trees in June and July the proportions should be one pound to three hundred gallons of water. For peach trees, Paris green only should be used, and this not stronger than one pound to two hundred, and possibly three hundred gallons of water. And for all trees late in the season, June and July, it is much safer to use Paris green than to use London purple. Probably it is the soluble arsenic that does the mischief, and this is likely to be present in considerable quantities in London purple, while it is nearly absent in Paris green.

Sixth—There seems no danger in turning stock into an orchard immediately after it has been sprayed with the arsenites. If properly sprayed—that is, sprayed with a dilute mixture as suggested above—the amount of poison which falls to the grass below, and which would be eaten, even if all the herbage was cropped by the stock, would be far too slight to do any harm. Chemical analysis, as well as direct experiment with horses, sheep and hogs, determines this question beyond any chance of error.

FIGHTING THE CURCULIO.

This year, as last, we sprayed our plum trees with London purple, and dusted them with carbolized plaster. We used one pound of London purple to two hundred gallons of water, and mixed one pint of strong, crude carbolic acid with fifty pounds of common land plaster. As last year, so this, we repeated each application twice, making three times in all. The results this year were very different from those of last year. Trees treated, like those untreated, lost every plum. This year we had hard rains almost every day. These doubtless so washed off the poison or plaster that they were no preventive of the work of the beetles. My experiments last year, together with those of Prof. C. M. Weed, of the Ohio station, in 1888 and 1889, and those of Prof. S. A. Forbes, of Illinois, show quite conclusively that the arsenites will prevent in great part the work of the curculio if we can keep the poison on the leaves and fruit. The same is true of carbolized plaster. But my experiments this season prove that in very rainy seasons the old jarring method is not only cheaper, but the only effective method yet known.

As suggested last year, the curculio prefers plums to apples; but in the absence of the plums they will attack most ruinously the apples. Apples seriously stung by the curculio become so gnarled and deformed as to be wholly worthless. Thus it becomes imperative to the best success that plum trees be set among the trees of the apple orchard. Then we have to spray the apple trees but once to subdue the codling moth, the several leaf-rollers, the canker worm and tent caterpillars, while we can jar the plum trees, or treat them two or three times with the arsenites or carbolized plaster, as circumstances seem to recommend. The plums will save the apples, and with pains to repel the curculio, may give as good returns as any product of the farm. I believe the same course may be profitably pursued in the cherry orchard. I believe the presence of abundant plum trees will save the cherry trees from the attack of the curculio, and so we shall get cherries—if we have enough to more than supply the birds—with no effort to repel injurious insects from the cherries themselves.

THE FLEA BEETLES.

In 1888 portions of New Jersey, New York and adjacent States were seriously injured by the depredations of the cucumber flea beetle, Crepidodera cucumeris Harr. These insects attacked the potatoes.

This year we resolved to investigate all the flea beetles in our vicinity in hopes to find good practical remedies for some or all of them. We were well supplied with material, as the grape flea beetle, Haltica chalybea Illig., the striped flea beetle, Phyllotreta vitata Fab., no less than the cucumber flea beetle, Crepidodera cucumeris, were each and all abundant in our region. The first worked only on the grape, which it injures seriously, both while in the larval and mature stage. As larvæ they feed on the foliage, as imago, or mature beetles, they work early in the spring, eating the buds. The striped flea beetles work on several plants, but worst on radishes and cabbages, while the third works on many plants, but most on potatoes, tomatoes and cucumbers. We tried many remedies, such as carbolized plaster, kerosene and soap mixture, dilute carbolic acid, gas lime, tobacco decoction, buhach, hellebore, ashes, lime, tobacco dust, London purple, ashes and London purple, turpentine and plaster, etc., etc. Few of all these substances seemed to work with any satisfaction. London purple and water, one pound of the poison to two hundred gallons of water, is quick death to the grape flea beetles, and is a cheap and satisfactory remedy for the mature beetles that attack the buds of the grape in early May. The same remedy, and also the kerosene and soap mixture, are both sure destruction to the larva of this insect which later in the season eats the grape foliage. I find the following to be the best compound to use in this warfare: One quart soft soap or one-fourth pound hard soap, two quarts of hot soft water and one pint kerosene oil. Stir this thoroughly till all mix permanently, then add water till the kerosene forms only one-fifteenth part of the whole. The best way to stir is to use a force pump and pump the liquid back into the the vessel containing it. This soon mixes it so that the oil will not rise to the top upon standing.

For the other two insects we only found two remedies that seemed at all satisfactory. Ashes dusted onto the affected plants seemed to repel the insects and save the plants. Yet success in this case required that the plants be entirely covered with the ashes. This not infrequently injured or appeared to injure the plants. Thus, while ashes will repel these flea beetles, they are not a desirable remedy. The other specific in this case was a strong tobacco decoction. I used tobacco dust, which I got very cheaply at a large tobacco factory in Detroit. I would take two large handfuls of this dust, pour boiling water on it, then use the water or decoction to sprinkle the affected plants. I used about one pound to two gallons of water. This was used on several plants for both the cucumber and striped beetles, and seemed in every case to bring immediate relief. While this seemed either to kill or drive off these beetles, it in no wise injured the plants. We shall try this again very thoroughly another year; but we feel already warranted in recommending it to any who have occasion to fight these very destructive little hopping beetles. It seems to be just what is wanted. If as effective to rid the grape-vines of the grape flea beetle in the early spring, it might be substituted for the London purple in that warfare.

INSECTS AND POTATO SCAB.

I planted potatoes in a field where very scabby potatoes were raised last year, and also some in boxes in the laboratory, in earth in which there was no insects. Those in the field were examined often. It was very rare that any insects were found near the potatoes, and never was there found a single myriapod. The scab began to appear while the potatoes were yet very small. This is but a repetition of similar experiments tried in previous years. I much doubt if insects have anything to do with scab on potatoes. I am very positive that the millipeds, or thousand legged worms, so-called, do not cause the scab on our Michigan potatoes. I expected to get positive results in the potatoes planted in boxes and kept in the laboratory. In these boxes there were no insects, and if we had succeeded in growing scabby potatoes we should have known that scab was independent of the work of insects. Unfortunately, however, while we had a very fine growth of vines, we raised no potatoes. Thus this effort was wholly fruitless. We shall repeat this trial another year, in hopes of better success.

INSECTS OF THE YEAR.

This has been quite a remarkable year for insects. Early in the season there was a general invasion of the corn fields of the State by the cut-worms. The season was very late at best. Much corn was not planted till in June, and even then it made a very slow growth. Following this was the attack by the cut-worms. Thus in many parts of the State the corn was largely a failure. The only remedy that is practical in defending against this pest is that of baiting by bunches of poisoned herbage. I have tried this only on a small scale, but have been so successful that I feel free to recommend the method to others. The best method to pursue is as follows: While the grass or clover is still standing in some meadow, spray it thoroughly with London purple; then carefully cut with a scythe, and draw it to the infested field and pitch small forkfuls among the corn plants, so that they may be quite close together, at least not farther separated than one or two rods. Some bind the herbage in small bundles, that it may remain fresh longer. The objection to this remedy is the expense, and the binding into bundles makes it more laborious and expensive, while I do not believe it materially adds to its effectiveness. Some who have tried this are not satisfied that it is effective. They say that they find no dead caterpillars. The poisoned cut-worms are apt to bury slightly in the earth before they die. That they are really killed is beyond question. The time to distribute the poisoned herbage in the garden where tomatoes and cabbages are to be set is just before the plants are to be transplanted. In the corn field, in case we find by close examination that the newly plowed sward is full of the hungry caterpillars, the poisoned grass or clover may be distributed just before or soon after the corn is up. If neglected till the insects commence cutting the plants it will yet pay to try this remedy, perhaps in a small way at first, and then, if found, as will probably be the case, that it works well it may wisely be tried more extensively. That this will surely pay in garden culture is beyond question; that it may prove valuable in general field culture I think more than probable.

THE GRAIN PLANT LOUSE.

The most startling insect development during the year was that of the grain plant louse, Aphis (Siphonophora) avæna L. This was remarkable, not only in showing how an insect may develop and increase to an enormous extent under favorable circumstances, but also as vividly showing how the insect enemies of any insect may in a remarkably short space of time so increase as to overwhelm their victims, even though the latter exist in countless myriads. The leading practical facts concerning this plant louse were given in Bulletins No. 50 and 51. I will add that I experimented to learn if we could destroy the lice by use of artificial remedies, and if such remedies would prove practicable. I tried several remedies. The kerosene and soap mixture is effective if the application is thorough enough. We used a hand pump, and sprayed the wheat very thoroughly, but we found that owing to the protection which the insects received from the kernels many were not touched and so remained uninjured. As we were much more thorough than would be possible in treating a whole field, I am led to the conclusion that any such remedy would never give satisfaction. We may well rejoice that we have such efficient aids in our insect friends that we shall never need to fight these grain plant lice with artificial remedies. Not only are the artificial remedies impracticable, because of necessary lack of thoroughness, but they are also undesirable, because of the large damage that is done to the grain in their use. We cannot drive through a grain field without causing serious destruction to the crop.

A NEW CLOTHES BEETLE.

During the past summer I have received from G. D. Perrigo, Portland, Michigan, many specimens of a minute beetle and the grubs or larvæ of the same, of which I wrote the following, which was presented before the American Entomological Club at the late meeting in Toronto, Canada.

One of the most interesting studies of the scientific entomologist—more interesting because of its economic importance—relates to variation in the habits of insects consequent upon change in their environment. The carpet beetle, Anthrenus Scrophulariæ Linn., feeds on flowers in its native Europe.

In the new atmosphere of America it feeds and thrives upon carpets, shawls and other woolen goods. The apple maggot, Trypeta pomonella Walsh, feeds upon our wild haw and other wild fruits. Civilization exterminates its old-time aliment and it betakes itself to our autumn apples, and this year I have found it on both cherries and plums. The curculio, apple-tree borers, bark lice, etc., are other illustrations of the same truth.

I have discovered the past season another illustration in the Lasioderma serricorne Fab. This insect belongs to the family Ptinidæ, a small family of very small insects. Very few of the insects of this family are noxious; the two best known of which are the apple-twig borer, Amphicerus bicaudatus Say, which in the mature state bores in the twigs of the apple tree, and Sinoxylon basilare Say, which attacks the hickory and grape. The insect in question, Losioderma serricorne Fab., has been found to attack plush furniture. The larvæ in this case do the mischief; they perforate the plush, making it like a sieve. Several pieces of valuable furniture were ruined by these minute larvæ.

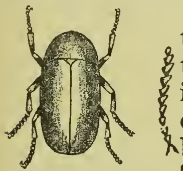


Fig. 1. Beetle.

The beetle (Fig. 1) is light brown in color. The color of the entire beetle is uniform, except that the eyes and tips of the elytra are black. The wing covers appear a little lighter in color, because of a covering of light hairs, which are more dense on the elytra than on the thorax and head. The thorax bends down so as we look from above we cannot see the head. The serrate antennæ, which give name to the beetle, are also bent under the head so that they likewise rarely show. The beetles are very small, hardly more than two mm. long. The elytra are non-striated. The first two joints of the antennæ are small. The following joints increase to the sixth, and then decrease to the end. The tenth or last joint is rounded. The grubs (Fig. 2) are short, curled and hairy. They are two mm. long and one thick. The color is white, as is also the hairs, though the latter have a slightly yellowish tinge. The six thoracic legs are tipped with black. The upper part of the head is marked with four yellowish-brown lines; the upper ones are narrow, while the latter ones are abbreviated behind. The front of the head is brown; the jaws and other mouth-parts nearly black.

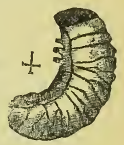


Fig. 2. Larva.

As these beetles are cosmopolites, and feed on various articles of commerce, even tobacco and cigars, we may well hope that this new habit will ever remain exceptional.

Like all insects, these beetles, both as grubs and mature beetles, are very susceptible to both gasoline and bisulphide of carbon. Either of these used freely were quickly fatal to the insects. Of course whenever either of these substances are used great care must be exercised that no fire be brought near till these inflammable liquids are evaporated, which, however, soon takes place. Like the carpet beetle, Anthrenus scrophulariæ Linn., so these insects infest upholstered furniture between the folds, especially where the back joins the seat. It is easy to drench such parts of a chair or sofa with gasoline and destroy the larvæ of moth or beetle.

Nearly every year brings examples of such change of habits as described above. Such incursions, present and prospective, emphasize the importance of a thoroughly trained entomologist in every State of our country.

THE WEE GRAIN BEETLE.

Not infrequently during the past few years have I found in rice and other culinary articles, specimens of a small, slender, brown beetle, which, though probably a native of the orient, has become, from its habits, scattered throughout the habitable globe. This little beetle is known to science as Silvanus surinamensis Linn. In 1881 I received this beetle from Breedsville, Michigan, where it was found seriously injuring the wheat and other grains. In 1882 a leading merchant of Detroit sent for me to come at once to his house, as a worse than the locust plague was inflicted upon him and his household. I hastened to Detroit and found his house fairly swarming with these same wee grain beetles. The elegant house of this gentleman was, through the rear rooms, connected with the nearly as elegant barn or stables. Upon examination I found that meal and other grains were kept perpetually in these stables. Further search discovered that these beetles were breeding in this meal, and that they existed in the barn in countless thousands. As they are very small and flat they could press between casings and windows, and under windows and doors, and so had taken, all uninvited, entire possession of the house, greatly to the horror and disgust of the family. This present season Mr. D. S. Hall, of Tecumseh, Michigan, has discovered the same pest in his wheat. To show in what fabulous numbers these gather upon the fated grain, I have only to say that Mr. Hall writes that he could easily collect one-fourth bushel of these minute beetles. He actually did collect one peck in cleaning 600 bushels of grain. This explains the emigration and wide spread dispersion at Detroit.

This beetle is referred to in the Government Agricultural Report for 1870, p. 66, in a brief illustrated article. It is stated that it feeds on various grain, apple seeds, and even leaf tobacco. A brief illustrated note occurs also in the American Entomologist, vol. 2, p. 339. Here a brief description of the beetle is given. The specimens were from Pennsylvania and were reported as very destructive to wheat, rye and oats. It is also stated that it makes the grain damp and warm, which fact is always observed where these wee grain beetles are present in force. Curtis, in his Farm Insects, p. 329, gives an excellent account of this insect, which is accompanied with a fine colored figure.

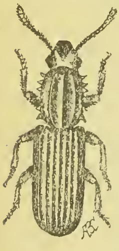


Fig. 3. Beetle.

This beetle (Fig. 3) is a narrow, flat brown insect. It belongs to the family Cucujidæ. Most of the insects of this family are flat, and generally are found resting under bark, as this is also said to do. It is very small, hardly 3 mm. (.12 in.) long. The pro-thorax is a little darker than are the wing covers. The antennæ are slightly enlarged at the end. The last three joints (See fig. 3) form this enlargement. There are on the upper surface of the pro-thorax three raised longitudinal lines, and six distinct teeth on each side. There are four similar lines on each wing cover. These ridges, however, are not so prominent as those of the pro-thorax. Between the raised lines of the wing covers are double rows of pits or punctures. Smaller punctures also cover the thorax and head. The femora or thighs are all enlarged, and the tarsi are all five jointed. Fine, short, light-colored hairs cover sparingly nearly the whole of the insect.

The grub or larva is cream colored. The head is prominent, the jaws large, and three jointed thoracic feet are plainly visible. It is a little longer than the beetle, or about 4 mm. long.

The pupa is a little shorter than the beetle. It is the same color as the larva, and has spinous projections on the sides of both the thorax and abdomen.

REMEDIES.

When these beetles are in a close box or bin, nothing is more effective to destroy them than is bisulphide of carbon. This very volatile liquid soon evaporates, and the deadly fumes are so penetrating that few beetles, even in a bin of grain, escape alive. In a bin or barrel the liquid can be applied at the bottom as follows: A piece of gas pipe, with a close fitting rod in it, is pushed into the grain. The rod is then withdrawn and the liquid poured into the pipe; after which the latter is quickly drawn out. A piece of oil cloth or a carriage robe spread over the bin or barrel to confine the vapors, aids the work. This remedy is excellent in all cases of insects that infest stored grain. There is only one objection—the danger of fire. This vapor is highly inflammable and explosive. A burning match or a lighted cigar might cause a disastrous explosion. It is to be said, however, that the vapors are soon dispersed, so that open doors and windows soon remove all danger. We see, then, that caution and a brief guarding of the premises are all that is required to remove all danger. At my suggestion one of the largest flour manufacturers of Michigan has entirely cleared one of his mills of insects, though the mill was terribly infested, by this remedy. His mill is in the very center of one of our largest cities; yet he was cautious and no danger was incurred. He buys his bisulphide of carbon by the barrel of the manufacturer at Cleveland, Ohio. Of course no one should breathe the poisonous vapors. In the case at Detroit we found that paper spread with lard or other grease would attract the beetles in prodigious numbers, when they could be easily and quickly destroyed. In this case they were so widely distributed that the bisulphide of carbon was not a practical remedy.

SQUASH BUG PARASITE.

Few of our noxious insects are more destructive or harder to combat than is the large dark colored squash bug, Anasa (Coreus) tristis De Geer. The method of trapping under chips, and of shaking into shallow vessels containing kerosene, though the best known remedies, are not very satisfactory. Thus I am happy to report that I have raised a dipterous parasite from this insect. This fact is doubly interesting, not only from the destructiveness of the bug, and the difficulty in combating it, but it gives a page in the life history of the fly which was before unknown.

TRICHOPODA PENNIPES FABR.

This fly has long been known as a common insect about gardens, but its habits or life history have not been previously known so far as I can learn. Dr. S. W. Williston writes me that he has this insect from all over the United States, from South America and St. Domingo. He further adds that he is not aware that the habits of this genus have been before known. He states that the nearly allied Phasia has been found parasite on Pentato mia, which is also a bug, and not greatly removed from the squash bug. Towend Glover refers to this species in his manuscript notes, p. 57, and gives a rather poor colored drawing, plate IV., fig. 14 Say, edited by Le Conte, Vol. II., p. 364, describes the male. I have reared a male from the squash bug, Anasa tristis. Say gives an admirable description which I should copy were it not that it is too technical for my purpose. He describes the male, which is a little smaller than the female, and has the smoky, opaque color on the whole front of the wings. The insect (Fig. 4) is of a dark gray, almost black color, with golden yellow lines on the thorax and between the eyes. The abdomen is yellow and brown. The front between the eyes has a shining, velvety black line, which is slightly concave on the sides. At the lower outer angles of this line extend black, curved, horn-like lines, which reach down to an imaginary line which would connect the base of the antennæ with the lower margin of the eyes. The remainder of the front is creamy white with a satin-like luster. The eyes are large and purple; at the top they reach to the black line, upon which are three ocelli. The antennæ are brownish, bordered with black in the male, and black in the female, except the base of the third joint, which is brown. The first joint is short, the second longer and the third still longer and oval. A simple bristle as long as the antenna extends from the outside, near the base, of the third joint. The beak is black, the palpi yellowish. The front part of the thorax is golden yellow, with four black lines extending lengthwise. The two central ones are narrowest—close together, so that they nearly touch in front, where they reach the anterior border of the thorax. The lateral lines are broader, and are abbreviated in front, so they do not reach the anterior margin. The abdomen is golden at base, becoming brown towards the tip. Osten Sacken says that the abdomen of the female is entirely ferruginous. I find that there is often very little difference in the abdomens of the sexes, though usually the male only has the black tip. In some they are brown to the tip, while others are dark at the tip, irrespective of sex. The wings of the male are smoky opaque, except a narrow transparent posterior border. In the female there is a yellowish anterior area reaching from the base of the wing, which is about one-third the width of the wing and two-thirds the length. The poisers are honey yellow, while the base of all the legs, reaching beyond the middle of the thighs, is brownish yellow. The remainder of the legs are black, except the pulvilli, which are almost white. The posterior tibia are fringed with scale-like hairs, broader in the female, where there are about eighteen. There are only about twelve in the male. Thus the name pennipes. The whole insect is hairy. The hairs are either black or white.

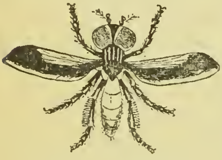


Fig 4. Female of Trichopoda pennipes.

The male is 7 mm. (.3 in.) long, the female 10 mm. (.4 in.).

These flies are quite common. If all have the same habit as the ones I raised from the squash bug, we may well wish them even more abundant.

THE APPLE MAGGOT.—TRYPETA POMONELLA WALSH.

For the past few years this insect has been a more or less troublesome pest in various portions of Michigan. In 1884 I gave in the Report of the State

Horticultural Society, page 200, an illustrated article on the insect. The remedy there recommended—feeding all apples on affected trees to swine, cattle or sheep, in early fall before the fruit fall to the ground, or at least before the insects leave the fruit—has been tried repeatedly in our State and with marked success.

This year I have received plums and late cherries from northern Michigan attacked by this same insect. So far as I know, this insect has not been previously reported as infesting either of these fruits.

EXPERIMENTS IN THE APIARY.

According to the plans adopted two years ago, the experiments in the Apiary are along four lines: Testing honey plants to determine whether any will pay for planting and growing exclusively for honey; breeding bees by crossing in hopes to secure a superior race; analyzing various kinds of honey to ascertain if any test for honey is possible and can be relied upon; and various points in manipulation, etc., which will come out with the year.

HONEY PLANTS.

The plants experimented with for the past season were Rocky Mountain bee plant (Cleome integrifolia), Chapman honey plant, Echinops spherocephalus, a mint, a species of Melissa, and Japanese buckwheat.

ROCKY MOUNTAIN BEE PLANT.

In growing this plant in small plats, as I have for years, I have previously learned that it does not germinate when sowed in the spring. Indeed the point has been raised against this plant that it is reluctant to start. From my experiments in small plats, I had not thought this an objection when the plants were sowed in the fall. Last autumn I sowed eight acres with this seed, obtained fresh from Colorado. A portion of the seed was sown early, the remainder quite late. All was dragged after sowing. The soil was very light sand, and had been cropped continuously for some years. Thus it was very weedy, and early in the spring I dragged the whole ground once over. None of the seed came well. That sowed latest came much the best. I am now of the opinion that the dragging both in the fall and spring were unfavorable to the welfare of the plants, as it was observed that about stumps, where balks or places not dragged occurred, the seed came much better. This seems the more reasonable, as in nature the seed is dropped early in the fall and is not at all covered. The plants in places came up well, but for the most part they were very scattering. The first blossoms opened June 13; June 24 the flowers were fully out. The bloom continued all through August. There were a few scattering blossoms even till frost came, the middle of September. Very likely there might have been more of these late blossoms had there been any rain. The bees worked on the flowers more or less all the season. At some times they fairly swarmed on the plants. There was a wood-lot between the apiary and the plants. Often the hum or roar of the bees was so loud in this wood-lot that persons walking through it were led to look for a bee tree.

It will be observed that this plant is in bloom from July 15 to August 15, just the period whern there is almost no natural honey bloom—the period between basswood or linden and fall bloom. This season (1889) was very exceptionally dry, and it is difficult to say how that affected the plants. It is certainly true that our bees kept storing all through the usual dearth, and what I never knew before, swarmed enormously the last of July and first half of August. I could but wish that our whole eight acres had been a sea of bloom. Another feature commendatory to this plant is the long period that it is in bloom—from early June till the end of summer. The honey from the plant is very excellent, both as to flavor and color. The fact that this plant thrives and yields abundance of honey on the arid plains of Colorado may also give us hope that with a full stand we could secure a crop even in our dryest seasons. We only need to learn how to grow it with success to be able to decide these points. I shall try it thoroughly till I know whether it will pay for special planting. I am arranging to plant a large area again this year. This year I shall plant on clay and also on light sand. I know it does well on sand. Some transplanted plants on clay, the past season, did very poorly. We are now arranging to plant the seed on clay to see if it will do better. We now know that it will keep bees busy and give some honey. We have reason to hope, that if abundant enough, it will give a good paying harvest.

CHAPMAN HONEY PLANT.

Of this we have about an acre. It was planted in the spring of 1888. It does not bloom the first season. We planted it in drills and cultivated it the first summer. The second season it grew very vigorously and possessed the ground. I think we need never cultivate this after the first season. This plant commenced to bloom July 19, and a week later was in full bloom. The season lasted just about a month, as by August 20 the blossoms were nearly all wilted. The bees worked on this plant with great energy early in the day, but not so eagerly afterwards. We grew this on strong clay land. We could but wish that it was eight acres instead of one. Next year we shall plant a large acreage on sand. The vigorous habit of this plant, the time of bloom—just during the honey dearth of July and August—and the fact that when once started it will hold its own with no care, are greatly in its favor as a honey plant. I think there can be no doubt but that it furnishes much excellent honey, though I hope to demonstrate this with a larger area of the plants. The objections to this plant are its failure to bloom the first season after planting and the fact that the bees do not hang to it actively all the day through, as they do to linden and clover. It will be noticed that the period of bloom is much shorter than is that of the cleome.

THE MELISSA HONEY PLANT.

This beautiful, very sweet mint grows about a foot high, and bears a beautiful white blossom. It is very sweet, and well may be called bee-balm. It is an annual and grows readily on either clay or sand. It commences to bloom about two and one-half months after sowing, and fairly rings with bees till frost kills the flowers. By sowing or planting in early May it will be in bloom by the time the honey dearth comes on. Though not so long in bloom as is the Rocky Mountain bee plant, yet it is a long bloomer, and covers the period of need. It should be planted as early as possible in the season. The points in favor of Melissa are, first, the ease with which it is cultivated, its long period of bloom and the abundant supply of beautiful honey which it affords. The points against it are that it must be planted each season unless it will come up from its own scattered seed, and I fear unless cultivated it would soon be run out by more vigorous and hardy plants. I am pleased with the results the past season, and shall continue to investigate till we know whether it will pay to plant specially for bees. If by planting eight or ten acres of some plant we can secure a crop, whereas without this we would secure no harvest; or if, by special planting, we can in good seasons double our crop of honey, then such information will be most valuale. If we find, as may be true, that special planting is not profitable, then all should know this fact, that the many may not waste money in fruitless experimentation. At the very least, these experiments will prove what plants are best adopted for special planting in waste places. I understand that already in places in Iowa and Wisconsin, cleome has secured a foothold and is much prized by bee-keepers.

JAPAN BUCKWHEAT.

We have continued our experiments with this variety of buckwheat the present season. Last season we sowed it on clay soil, early and at the usual time of sowing, and secured a great crop, although the land was hard and unfertile and the season dry. This year I sowed it on light sand and on clay. I sowed it on June 15 and June 30. Although the season was very dry, both sowings on both soils gave a fair yield of very fine seed. It was in full bloom four weeks after sowing. That we might have data for comparison, three equal plats were sown side by side on soil that was about the same. The middle plat was Japanese, the outside plats silver hull and common buckwheat, respectively. These plats were sown late, and the ground was very dry and parched. The outside plats gave no seed at all—just nothing—while the Japanese, though not great, gave considerable fine seed.

I feel more than warranted in recommending all to sow this variety, if they wish to grow buckwheat. Now it can be purchased for from $0.75 to $1.00 per bushel for seed. It is far more productive than either the common or silver hull varieties. The seed is larger and finer, and it matures earlier. This last not only prevents destruction from early frost, but makes this variety more valuable for bee-keepers, as the earlier the bloom the better. Again, we find this variety proves as productive and reliable when sown the middle of June as when sown the first of July. If sown at this earlier date, the blossoms coming in full force, a month later, are just in time for the bees at the beginning of the honey dearth, from July 15 to August 15, between the harvests of basswood and fall flowers. Again, the plant will be out of bloom when the asters and golden rods, etc., commence to afford nectar, and so the inferior buckwheat honey will not be mixed with that from the fall flowers. Lastly it stands the drouth much better than the old varieties.

EXPERIMENTS IN BREEDING BEES.

Our second point—breeding a special race by crossing the best known races, and carefully selecting and breeding from the best of these hybrids—will only prove valuable after several years, if at all. Already we are pleased, however. We have crossed the Syrian and the Carniolans. Our bees have now, in some degree, the activity and prolificness of the Syrians and the amiability of the Carniolans. We wish still further to heighten their good qualities and to render fixed those already secured. We hope to continue this experiment for several years.

TESTING HONEY.

We are still making collections of different kinds of honey, or of honey from different known sources. Owing to the varied sources from which honey is derived, it seems very probable that its composition is very varied. It is also well known that honey is digested nectar. I have reason to believe that in case honey is produced very rapidly, as when bees are collecting nectar from linden, the digestion is somewhat imperfect, and so the honey will contain more cane sugar and less reducible sugar. On the other hand, when the honey is stored more slowly, as from the mints and clover, the digestion is more perfect. Thus we are securing honey from all sources; that collected rapidly and that more slowly stored. We shall also feed cane sugar as rapidly as the bees can store it, and also slowly, to see if we can notice any difference in the degree of transformation from cane to reducible sugar. It is hoped that we shall have sufficient material to investigate this matter thoroughly the coming season, when I believe we shall show that neither the chemical test—reduction of the copper salts—or the polariscopic test—deflection of the polarized ray—are reliable in testing honey. When we find that we need a better test, then we may expect that it will be forthcoming.

EXPERIMENTS WITH CHLOROFORM.

It is very desirable that the bee-keeper should be able to introduce easily, quickly and safely, *any* queen at *any* time, whether virgin or mated. We experimented quite extensively in this direction the past season. We often took virgin queens, three and four days from their so-called hatching—their emergence from the queen cells. We first removed the old queen; then with a common bee smoker, in the fire tube of which were three sponges, the lower and upper tight fitting, and the middle wet with ether or chloroform, we forced the quieting fumes into the hive. This was done till the bees would fall freely to the bottom of the hive. The new queen, old or young, virgin or mated, was then allowed to enter. In no case do we know that the queen was destroyed. In nearly every case the queen was found upon subsequent examination, safe and busy in the hive. In a few cases where virgin queens were introduced, they had disappeared two days later. It is probable that these were lost in mating. We lost, a year ago, a much larger number that were not removed at all from the nuclei. In our new apiary we have no trees; only hives on a smoothly kept lawn. In our old apiary, with an evergreen at each hive, we rarely lost a queen in mating.

Now it is not very uncommon. From our experiments this season, we are led to the belief that by use of chloroform, queens, old or young, virgin or mated, may be almost if not always safely introduced. We could see no harm to the bees from the use of the anæsthetic.

We also tried in a small way this same method to cure the swarming impulse. We destroyed all queens' cells and saw that the bees had plenty of room to work, while they were under the influence of the chloroform. In the few cases tried there was no further preparation for swarming, or attempt to swarm. We shall try both these plans another year very thoroughly, that we may advise positively as to the excellence of the methods. We are prepared now to recommend them tentatively.

REMOVING QUEENS DURING THE HARVEST.

We tried the following experiments in hopes to find whether it were best to remove queens during the season of gathering, that in the lapse of breeding, more honey might be secured. The season was a *very poor* one. We tried to select colonies of about the same strength and vigor. Of two colonies worked for extracted honey, neither of which swarmed, the one with queen gave us during the clover and basswood season season fifty-one (51) lbs.; the one without queen only twenty-six (26) lbs. This case seemed exceptional. We can offer no explanation or suggestion as to the cause. Six colonies worked for comb honey that made no attempt to swarm —the sections were on the hive at the very dawn of the harvest—gave respectively 31 lbs., 28 lbs., 21 lbs., 25 lbs., 23 lbs., and 24 lbs. This gives a total of 152 lbs., or an average per colony of $25\frac{1}{3}$ lbs. Five colonies run for comb honey, whose queens were removed, made respectively 55 lbs., 35 lbs.—these two colonies were in restricted hives, in the lower section of a Heddon hive—24 lbs., 32 lbs., and 32 lbs. Here the total was 178 lbs; the average per colony $35\frac{3}{5}$ lbs. It would seem that restricting the brood chamber in this case was an aid. We should have weighed the hives before and after the experiment to see how much honey was stored in the body of the hive. This, however, we neglected to do. The results are only suggestive. Another year with a better harvest may give more decided results. The actual practice, in this case, would seem to support theory that in a colony with no queen, and so with no maturing brood, but contented, as they were not without means to rear a queen, would produce more honey than a colony with a queen, and where rapid brood-rearing was continually in progress.

FEEDING BACK.

At the close of the basswood season, a colony with partially filled sections was given a restricted brood-chamber so that it could not store except in the sections. The queen was removed, and it was fed thirty-seven pounds of good thick extracted honey. The sections increased thirty pounds, so we conclude that thirty pounds were stored. Another colony in one section Heddon hive were given unfinished sections weighing eighty pounds. They were fed twenty pounds of extracted honey, and the sections were filled and sealed and weighed one hundred pounds. It would seem that this colony must have gathered some honey, at the time, from the outside, though a colony on the scales seemed hardly more than to hold its own and the other colonies in the apiary did not seem to gain much, though all did gather enough to hold their weights. I believe in this matter of feeding back at the close of the season, we have a promising field for experimentation. We shall try to do much in that line another year.

CUCKOO BEES.

Cuckoo bees are such as enter the nests of other bees for the purpose of laying their eggs and having their brood fed and cared for by others. This name was doubtless applied to these bees from the similar habit of the English cuckoo. This bird, like the cow-bird in our own country, lays its eggs in the nests of other birds. Thus incubation, and the subsequent feeding and guarding, is performed by other than the parent bird. It has long been known that species of the genus Apathus—wild solitary bees—are wont to steal into the nests of bumble bees, where they lay their eggs. Thus the bumble bees feed and care for the larvæ of these wild solitary bees, which are thus relieved from all trouble and care. In my Bee Keepers' Guide, page 29, I say: "A few of the Apidæ—thieves by nature—cuckoo-like, steal unbidden into the nests of other bees and lay their eggs. As their young are fed and fostered by another, such bees gather no pollen, and so, like drone bees, need no organs for collecting pollen. These parasites illustrate mimicry, already described, as they look so like the foster-mothers of their own young that unscientific eyes would fail to distinguish them. Probably the bees thus imposed upon are no sharper, or they would refuse ingress to these merciless vagrants." I think I might have added: There is doubtless protective scent, for often the color mimicry is not so close; and more, these same bees would repel an intruder of their own species of another colony without mercy. In the Bee Keepers' Guide, page 34, I say further: "Other bees—the numerous species of Nomada and Apathus, are the black sheep in the bee family. These tramps steal in upon the unwary, and, though all unbidden, lay their eggs—in this way appropriating food and lodgings for their own yet unborn. Thus these insect vagabonds impose upon the unsuspecting foster-mothers in these violated homes, and these same foster-mothers show by their tender care of these merciless intruders that they are miserably fooled, for they carefully guard and feed infant bees which, with age, will in turn practice this same nefarious trickery. The Apathus species are parasite on the Bombus." So far as I know these bees have never been known to invade the sanctity of the hive before this year. This year they have been known in several cases, more especially in Indiana, to breed in the hive of the honey bee. In some cases hundreds have been found in a colony of bees. This is a matter of much scientific and practical interest. These bees are solitary. That is, they do not live in colonies as do ants, bumble bees and honey bees. The female mates, then hastens, not always to the nests of bumble bees, as we now know, but also to the populous hive of the honey bee. It is strange that they are permitted to enter; but they are, with no seeming opposition. Once in the eggs are laid in the cells, and the Apathus larvæ cared for as though they were veritable honey bees. I have received several mutilated specimens of these bees. I am sure that they are Apathus; but I am uncertain regarding the species. I shall be able to determine this point another season. Just how much harm these bees may do I cannot tell. If they only reach a few score in each colony of bees, we need not be anxious regarding them; if they reach thousands then they would become a serious pest. It will be necessary to learn their entire life history before we can measure their possible damage. We can say more when we know how they pass the winter.

In 1888, early in the season, my assistant was called to the experimental station of another State. This year the misfortune was repeated. Of course it is not possible to do the most satisfactory work unless we can keep our assistants. We must not only keep the men aiding us for the entire year, but we must be able to keep the same man a succession of years. In my opinion this is a matter worthy of serious consideration. I wish in this connection to express my hearty appreciation of the good work of my assistants the past season. Messrs. A. B. Cordley, C. B. Cook, F. H. Hillman and F. J. Niswander have all aided me, and each has done excellent, conscientious work. Each has seemed deeply interested in the work.

A. J. COOK.

REPORT OF THE BOTANIST.

To Oscar Clute, M. S., Director of the Experiment Station:

DEAR SIR—I herewith submit my second annual report for the year closing June 30, 1889:

I need not tell you nor any of our readers that this date is a most unfortunate one for reporting the progress of any out-door experiments, as it necessitates the placing of two halves of a report of two different growing seasons.

At the outset it becomes necessary for the reader to familiarize himself with the report for 1888. Three visits have been made during the year to each of the northern stations. The work is done by hired help and is not always done well nor strictly in accordance with the directions given.

EXPERIMENTS AT GRAYLING.

The plats of grasses and other forage plants are on old land rented of Mr. Brink, and the reader may remember are each one rod square. The soil is typical jack-pine plains and has been previously cropped for several years with little or no manure of any kind. As everyone had reason to expect, a large number of the grass plats amounted to nothing. The seeds of some failed to germinate; others germinated, but the plants remained small and soon perished for one or more reasons; others have established themselves and still retain life; some have made a small growth; others have done pretty well.

In addition to what were sown when my last report was made, are the following, sown September 21. The seeds sown this spring came up better than those sown a year ago:

Achillea Millefolium L.
(Yarrow Milfoil.)
Agropyrum caninum R. & S.
(A Wild Grass.)
Agropyrum dasystachium Vasey.
(A Wild Grass.)
Agropyrum divergens Nees.
(A Wild Grass.)
Agropyrum glaucum R. & S.
(A Wild Grass.)
Agropyrum tenerum Vasey.
(A Wild Grass.)
Agropyrum unilaterale Vasey & Scribner.
(A Wild Grass.)
Agrostis alba L.
(Red Top.)
Agrostis scabra Willd.
(Hair Grass.)
Agrostis stolonifera L.
(Creeping Red Top.)
Alopecurus pratensis L.
(Meadow Foxtail.)

Ammophila longifolia Benth.
(A Wild Grass.)
Andropogon provincialis Lam.
(Turkey Foot Grass.)
Andropogon scoparius Michx.
(A Wild Grass.)
Arrhenatherum avenaceum Beauv.
(Tall Oat Grass.)
Asprella hystrix Willd.
(Bottle Grass. A Wild Grass.)
Avena flavescens L.
(Yellow Oat Grass.)
Avena nuda L.
(Naked Oats.)
Berckmannia erucæformis Host. var. *uniflorus.*
(Scrib.)
Bouteloua hirsuta Lag.
(A Wild Grass.)
Bouteloua racemosa Lag.
(A Wild Grass.)
Brachyelytrum cristatum Beauv.
(A Wild Grass.)
Briza maxima L.
(Introduced.)
Bromus ciliatus L.
(Introduced.)
Bromus imernis.
(Introduced.)
Bromus secalinus L.
(Chess. Introduced.)
Capparis herbacea.
(From Russia.)
Cenchrus catharticus.
(From Russia.)
Cenchrus montanus.
(From Russia.)
Chloris barbata.
(Introduced.)
Chrysopogon nutans Benth.
(A Wild Grass.)
Cinna arundinacea L.
(A Wild Grass.)
Cynosurus cristatus.
(Crested Dogstail Grass. Introduced.)
Dactylis glomerata L.
(Orchard Grass.)
Deschampsia. ?
Deyeuxia Canadensis Beauv.
(Blue Joint.)
Eatonia Pennsylvanica Gray.
(A Wild Grass.)
Eleusine flagelliflora.
(From Russia.)
Eleusine scindica.
(From Russia.)
Elionurus hirsutus.
(From Russia.)
Elymus arenarius.
(From Russia.)
Elymus Canadensis L.
(A Wild Grass.)
Elymus Europeus.
(A European Grass.)
Elymus striatus Willd.
(A Wild Grass.)
Elymus Virginicus L.
(A Wild Grass.)
Eragrostis major Host.
(Introduced.)
Eragrostis viscosa.
(From Russia.)
Festuca duriuscula L.
(Hard Fescue.)
Festuca elatior L.
(Tall Fescue.)
Festuca nutans Willd.
(A Native Grass.)
Festuca ovina L.
(Sheep's Fescue.)
Festuca ovina var.
Festuca pratensis L.
(Meadow Fescue.)
Festuca rubra L.
(Red Fescue.)
Festuca tenella Willd.
(A Native Grass.)
Glyceria arundinacea Kunth.
(A Native Grass.)
Glyceria Canadensis Trin.
(A Native Grass.)
Glyceria fluitans R. Br.
(A Native Grass.)
Glyceria nervata Trin.
(A Native Grass.)
Holcus lanatus L.
(Velvet Grass.)
Hordeum jubatum L.
(Wild Barley.)
Iseilema laxum.
(From Russia.)

Kœleria cristata Pers.
(A Native Grass.)
Leersia oryzoides Swz.
(A Native Grass.)
Lespedeza striata.
Linum usitatissimum L. var. *macrospermum.*
(Large Seeded Flax.)
Lolium Italicum L.
(Italian Rye Grass.)
Lolium temulentum L.
(Darnel.)
Medicago sativa L.
(Lucerne. Alfalfa.)
Melilotus alba Lam.
(White Melilotus.)
Molinia cœrulea Mœnch.
(Introduced.)
Muhlenbergia Mexicana Trin.
(A Native Grass.)
Onobrychis sativa Lam.
(Sain-Foin.)
Oryzopsis melanocarpa Muhl.
(A Native Grass.)
Panicum capillare L.
(Witch Grass.)
Panicum Crus-galli L.
(Barnyard Grass.)
Panicum glabrum Gand.
(Introduced.)
Panicum miliaceum L.
(Millet.)
Panicum sanguinale L.
(Finger Grass.)
Panicum virgatum L.
(A Native Grass.)
Pennisetum cenchroides Rich.
(From Russia.)
Phalaris arundinacea L. var. *picta.*
(Reed Canary Grass.)
Phleum pratense L.
(Timothy.)
Plantago lanceolata L.
(Rib Grass.)
Poa compressa L.
(Flat-Stemmed Poa.)
Poa Nevadensis Vasey.
(From the West.)
Poa serotina Ehrh.
(Fowl Meadow Grass.)
Poa trivialis L.
(From Europe.)
Raphanus sativus L.
(From Russia.)
Setaria glauca Beauv.
(Pigeon Grass.)
Setaria viridis Beauv.
(Pigeon Grass.)
Soja hispida var. *chlorosperma.*
(From Russia.)
Spartina cynosuroides Willd.
(A Native Grass.)
Sporobolus cryptandrus Gray.
(A Native Grass.)
Sporobolus heterolepis Gray.
(A Native Grass.)
Trifolium hybridum L.
(Alsike Clover.)
Trifolium medium L.
(Mammoth Clover.)
Trifolium pratense L.
(Red Clover.)
Trifolium repens L.
(White Clover.)

The Niagara grape vine, presented by E. M. Roffee, Clyde, N. Y., last year sent out two or three slender shoots, the longest of which was two feet long. They all winter-killed, or at least died back to the ground. This spring the first shoots were killed by the late frosts, and on June 30 there were several feeble shoots two or three inches long still growing below the surface of the soil. I never expect to see luscious Niagaras grown at Grayling in the open air.

The Russian trees, planted in the spring of 1888, still remain where first set. There were thirty-five species in all, some in the form of cuttings, only two to ten of each kind. The number of each was too small to warrant any conclusions at this time as to their value. Some have died, a few have done very well, and on the whole they seem to promise more for this soil and climate than most of our natives.

Of the forty-one species of native and European trees planted in the spring of 1888, a good many died, either during the summer or the succeeding winter. There may be a good deal in the unusual nature of the past year to cause the death of young trees. Some varieties were killed; further trials will be made, and when there is anything definite to report, so that anyone can be warranted in drawing conclusions, the results will be given. Cuttings, six or eight inches long, of one year's growth, nearly all died. If cuttings are set in the open field, they should be much longer and rather larger.

The trees planted on land simply harrowed, or not even harrowed, are not promising at present.

This spring about an acre of ground was plowed for the first time and set to small trees of white pine, Norway pine, Norway spruce, box-elder and locust. Some seeds of pitch pine, *Pinus rigida* Mill., were sown in two or three places and many of them have come up. Chestnuts were also planted.

WALTON.

In this connection I can do no better than take notes from an article prepared for the *Grand Traverse Herald,* and published on April 11, 1889:

"The spring last year was very cold and backward, and the summer unusually dry. Everything had to be got ready, the land selected, prepared, and seed purchased and sown. We had nothing certain about money to use in this way till late in February, 1888. The seeds were put in on May 11.

"The land was rented of Abram F. Philips, and is enclosed by a board fence. It joins the Traverse City branch on the north side of the railroad track, about one mile from the village of Walton, and may be seen as trains pass the spot.

"The Experiment Station year closes on June 30 of each year, hence at that early day my first report, not long since printed in the report of the Board of Agriculture, could not contain much information on the experiments.

"The land is divided into plats of about one-fourth of an acre each. It formerly contained a few small white oaks, scattering Norway pines, a few inferior white pines and numerous trees of jack pine. It had never been plowed until last spring. The roots of sweet ferns, brakes, huckleberries, bearberries, morning-glories, willows and numerous other species of small, woody and herbaceous plants are tough and numerous, and some of them very large and slow to decay. The land was plowed, harrowed, the seed sown broadcast, and then rolled. No fertilizers of any sort were used. There was one plat of Hungarian grass, one of German millet, one each of rye, meadow fescue, alfalfa or Lucerne, alsike clover, June grass, Timothy, Italian rye grass, spurry, perennial rye grass, meadow foxtail, field peas, mammoth clover, red clover, sweet clover, orchard grass, tall oat grass, one of a mixture of mammoth clover and orchard grass, one of a mixture of tall oat grass and orchard grass, and one with eight sorts sown on the same plat, viz.: Fowl meadow grass, orchard grass, Timothy, tall oat grass, perennial rye grass, meadow fox-tail, red clover, mammoth clover.

"Adjoining these plats was another, where the land was picked up and simply scratched over with a spring-tooth harrow. On this seven sorts were sown. Adjoining that was another plat where no preparations had been made—no cultivation. On this seven sorts were sown. The place was visited three times after the seed was sown, the last of which was on October 18. At that time there were no very flattering notes to be made. Some of them were as follows: Rye, thin, two and one-half feet high, better than that at Oscoda; millet and Hungarian very thick, some of it eighteen inches high; alfalfa spindling, hardly thick enough; the roots are as large as pipe-stems and the plant is getting down to business so that it is difficult to pull it up. Where eight sorts were sown, the ground is evenly and thickly covered and appears the most promising of any. June grass is hardly to be seen anywhere, and then very small. Alsike clover is too thin, but makes some show; a few plants have seeded. Meadow fescue has some good patches. Spurry is about a foot high and very thick. Italian rye grass looks well, all things considered; Timothy thin and poor; peas a small, thin crop; meadow foxtail too thin, will need seeding over; perennial rye grass much ahead of Timothy; sweet clover very pale and thin with long, large roots; red cover a thin catch, a very little of it seeding; mammoth clover thick and better; orchard grass makes a very good showing, beating Timothy by all odds; tall oat grass thin and spotted, some three feet high.

"There is quite a 'sprinkling' of wild stuff still growing among the grasses. Huckleberries, sweet ferns, brakes, bearberries, asters, golden rod, dewberries, and many other plants turned about after the land was plowed and soon came to light right end up, as though nothing had happened. In fact, they seemed to enjoy the little cultivation the land had received, as a good share had been killed, leaving a better chance for the survivors.

"Hon. C. W. Garfield, a member of the State Board of Agriculture, and formerly secretary of the State Horticultural Society, was with me on the last visit, and enjoyed the examination of the specimens very much.

"I have often been asked in person and by letter what I thought was the outlook for successful farming on these lands. I expect to promise nothing, but give results as fast as they are obtained. I am quite inclined to agree with the general verdict, that the lands are entitled to rank as poor, that most likely it will be natural for people to buy the best lands just when they are about to go into farming, at least while good lands are cheap and abundant, as they still are in northern Michigan.

"We left the station on the evening of October 18, after hard frosts had killed all tender vegetation. Growth had ceased, and plants of all sorts had got ready for the long sleep of a six months' winter.

"On April 9, 1889, as the snow banks had crept behind the fences or retreated to the dense forests, the ice melted away, the robins returned for nesting, the frogs revived, the pussy willows appeared, the elders began to lengthen their limbered catkins and shed their pollen, I was anxious again to see how things looked at the experiment stations.

"The winter had been unusually open. Of course we all know that rye, millet, Hungarian grass and peas which seeded last year would die in autumn. Spurry is a chickweed-like plant, and is also an annual. It has been successfully used in some parts of Europe as a 'starter' on poor, sandy land. It makes good food for live stock. Last autumn the crop of seed was abundant and much of it had sprouted and rooted. These young plants are all dead. Whether there are yet enough seeds still living for another crop this year I cannot now tell. We will wait and see.

"Italian rye grass in the old country is called an annual. It has always proved such during many years of experimenting at the Agricultural College. To my surprise and gratification none of it died last winter in Traverse county. Perhaps the growth was so small it was not fit to die, and nature dealt gently with it. The other grasses and clovers all lived. I could not find a single plant that had suffered. The sweet clover is not thought to be of any use for pasture or hay, but it has been mentioned as a promising plant for plowing under to enrich the land.

"The side buds are already pushing just at the surface of the ground. Every one is watching the alfalfa with much interest. It is now beginning to grow, but it is yet too soon to predict success for it on the sands of Michigan. Lucerne is the French name for the same plant. The young plants are rather slow to get well established; it is not suitable for pasture anywhere, but is a favorite in some regions for mowing. For good hay it should be cut before it blossoms or very soon after, and cured as we cure red clover.

"On studying the ground over again this spring I think we are learning something. I have patched some plats by another seeding. I am trying a little rotted barn-yard manure on a small part of many of the plants, also gypsum, or, plaster, on the clover and on spurry, but not on the grasses. I shall use a very little homestead superphosphate, sown two or three times on a small part of each plat. In this way, with many questions from all sources, and open eyes, and new grasses and clover from other sources, I still hope to be able in due time to arrive at conclusions which shall be interesting and valuable to all citizens of Michigan, and whichever way the question is decided in the end, the experiments will be worth a thousand-fold what they will cost."

Among other things, on June 28 the following notes were made: Season very early and dry till near the end of May; June usually wet and cool. The piece only harrowed (not plowed) and sown with seven sorts has made some progress, and begins to look as though it would finally make some headway. The sorts sowed on land neither harrowed nor plowed have made no start.

Manure and superphosphate, the latter sown once, improve orchard grass and mammoth clover, in same plat together, to about the same extent.

I cannot see that superphosphate improves orchard grass and tall oat grass sown together; manure has helped both species.

Superphosphate on orchard grass alone doesn't seem to have helped it, while barn-yard manure has produced a marked effect.

The tall oat grass is thin, not as good as I had expected it would be.

Sweet clover is also very scattering and spindling; nearly all had been eaten to the ground by cut-worms, but was sprouting just below the surface of the ground.

Red clover does not seem so promising as mammoth clover. On a patch of mammoth clover the superphosphate seems to have done more good than the top dressing of barn-yard manure, but it must be remembered that the piece is small, that there may be some difference in the land, that I am unable to know for certain just how much manure was used or how much superphosphate. The notes in regard to this rough experiment are given as indicating the nature of further and more extended experiments more carefully made.

Much of the spurry sprouted last fall and died. Some seed remained over winter, and patches of the plants are seen here and there.

Timothy is very thin, some of it two feet high.

June grass sown last year is very thin and small, and that sown this spring is very slender, some of it an inch high.

Alsike clover pleases all who see it; bees are working freely on the numerous blossoms. The plants are rather thin on the ground and each plant spreads, but I believe mammoth clover in August will cut the most in weight. Manure helps the alsike clover, but superphosphate seems to have helped it still more.

The alfalfa is thin, slender, ten inches high, and probably is pining for more heat.

Meadow fescue is two and one-half feet high and in flower. Plants are thin, but make quite a display; on the whole better than the Timothy.

Strawberries are spreading quite freely and some are in fruit, or have been this season. They are common on the plains.

Mr. R. Knaggs, in the village, has raised good strawberries year after year on the same ground without any manure.

BALDWIN.

The plats at this place nearly repeat those at Walton previously noticed. I give a few notes taken on June 29, of this year:

Where nine species were sown on new land after it had merely been harrowed once, there is rarely a plant to be seen of the species sown. Mammoth clover covers two-thirds of the ground where it was sown last year after plowing, and is twenty inches high. Early red clover is thinner and shorter; orchard grass patchy and very short; alsike clover spreading, not so good as at Walton; Timothy one-half to two feet high; tall oat grass three to five feet high, but found in scattering bunches. But little was sown. The ground in this plat may be rather better than that of some others. No spurry was seen. Where nine sorts were sown together on cultivated ground the grasses are thickest and best of all the plats. There is a very good crop, the clovers predominating.

Through some mismanagement no superphosphate was sown at Baldwin, and but very little manure could be obtained at the stables in the village. A little plaster was sown on a part of each of the plats and seems to have done a little good.

HARRISON.

The old land mentioned in my last report had been cropped six or more times in succession without the use of any fertilizers or without seeding to grass or clover. It was very thin. The land leased was part of a large field of an abandoned farm. The fence was very poor. The owner declined to keep it in repair for another year. This part of the work at Harrison has been abandoned. The experiments of a single season have helped to indicate that there is no use in cropping or seeding such land to anything without the use of fertilizers of some kind.

The ten acres of new land given us by Messrs. Wilson will next be noticed. Half of it was plowed for the first time last fall. The south two acres were well "grubbed" before plowing; the three acres north of the south two acres were not "grubbed" before plowing. The five acres plowed last fall were rolled and harrowed well this spring and seeded as follows: A piece of alfalfa, a piece of tall oat grass, one of orchard grass, one of perennial rye grass, one of alsike clover, one of mammoth clover, one of red clover, and one containing a mixture of red clover, mammoth clover, alsike clover, alfalfa, perennial rye grass, tall oat grass, orchard grass and Timothy. A piece in each case, about twenty feet square, had a liberal dressing after seeding of fairly well rotted barn-yard manure.

The spring, soon after seeding, was wet and the seeds have all started nicely; some of the tall oat grass was eighteen inches high when the place was examined. The man in charge of the work moved away, and hence did not sow the superphosphate according to the plan.

OSCODA OR AU SABLE.

In October of last year the notes regarding the grass plats may well be summarized by saying "plants thin, scattering and small." In April about twenty feet square on each plat was well top-dressed with fine manure, and near a stake put in the center of all plats of clovers, spurry, alfalfa and sweet clover, there was sown about two quarts of superphosphate to a rod. On July 5, 1889, I took notes and now report the following:

The barn-yard manure has helped everything on which it was applied.

Spurry, self-sown last fall, is thick enough on half of the ground; eight inches high; superphosphate seems to help it.

Red clover sown in the spring of 1888; a few patches are fair; the rest of the ground is well covered with sorrel.

Meadow fescue sown in the spring of 1888 is very thin, but quite evenly scattered; two and a half feet high.

Sweet clover sown in the spring of 1888; there is a little at the south end; it is of no account.

Timothy sown in the spring of 1888 is very thin, hardly as good as meadow fescue.

Red clover and mammoth clover sown this spring is coming up well.

Alfafa is very thin and a foot high; the manure and the superphosphate appear to have helped it about the same degree.

Alsike clover sown in the spring of 1888 is now patchy, small, spreading and in flower.

Meadow foxtail sown in the spring of 1888; there is but a very little and that is about two and a half feet high.

Mammoth clover is as promising as anything.

June grass sown last spring and again this spring makes a very poor showing.

Italian rye grass and perennial rye grass sown in spring of 1888 are much alike; thin, a foot high.

Clover seeded this spring is helped by superphosphate as well as by manure.

Trees were planted on about an acre of new land this spring.

The land was plowed for the first time and then harrowed. The small groves and scattering trees of jack pine were left standing. The trees were in rows east and west, four feet apart. They have been hoed and will be hoed again and again. They were too small, being about six inches high. The species consisted of white pine, Norway pine, Norway spruce, box elder, locust and some seeds of pitch pine, *pinus rigida*.

EXPERIMENTS AT THE COLLEGE.

To fully understand what follows, the reader must first read the last report as found on pages 141 and 178 of Michigan Board of Agriculture for 1888. The sizes of the plats are mostly sixteen feet square. In case the plat is a prominent one, the plat is about thirty feet square or even larger.

Full notes are made from time to time in regard to the success or failure of each species.

At present we have no conclusive experiments or observations to report on this subject.

It would be difficult to imagine a more unfavorable fall and spring than the last has been for the purpose of establishing anything like a complete set of grass plats. Many of the grasses are delicate and difficult to start at best, and even those in common cultivation have, in many cases, proved unequal to the task of forming a perfect seeding.

About seventy-five sorts were sowed in the fall, beginning about the time of wheat-sowing. Some of the earliest sowed sprouted last fall, but more did not show above ground till spring, and at this writing (June 20) not a few are only just pricking through after nearly nine months in the ground. Time and season certainly are factors in the germination of many seeds, as well as are heat and moisture. Still others have not yet appeared above ground, and whether this is from poor seed or some other cause remains to be seen.

One plat seeded to chess was a great success, and, though thinly seeded, it was the first to appear, has been the greenest spot in the field, and has been lodged from its heavy growth since June 1. Many passers-by refuse to believe it is from chess seeds, and in the spring offers were freely made to bet money that the plat was oats. Such is still the lingering prejudice regarding the origin of chess, happily fast disappearing, however, before better farming and more exact knowledge.

About one hundred plats were seeded in the spring and are looking well, but their ultimate success will depend largely on the succeeding weather. One plat of about a half acre was seeded to a mixture of one hundred sorts of grasses and clovers, with the object of watching the battle for standing-room and nutriment. The seeding is somewhat thin and in a variety of soils. Certain features of a plant can be tested in no better way than by placing it where competition is sharp and where the struggle for existence is severe.

Besides most of the common American native and cultivated grasses and clovers, there are started some twenty sorts of Russian forage plants. An assortment of seeds from India arrived too late for spring planting, but will be planted this fall. We have not yet succeeded in securing seeds from eastern Asia or southern South America, but the plan is not abandoned, and it is more than likely that among the many sorts native there, some might be found of great value here.

Four plats of the original sod, at least twenty years old, have been preserved as permanent meadow or pasture to be compared with newer seeding.

Appended is an alphabetical list of the varieties already planted, excluding a few that have not yet appeared above ground and are not likely to come. Of many sorts there are duplicate plats of seeds from different localities.

Agropyrum caninum R. & S.
“ *dasystachyum* Vasey.
“ *divergens* Nees.
“ *glaucum* R. & S.
“ *repens* Beauv.
“ *tenerum* Vasey.
“ *unilaterale* V. & S.
Agrostis Abyssinica.
“ *asperifolia* Trin.
“ *canina* Linn.
“ *dispar.*
“ *scabra* Willd.
“ *vulgaris* With.
“ *vulgaris var. alba* (red top) (*A. alba* Linn.)
Agrostis vulgaris var. stolonifera. (*A. Stolonifera* Linn.)
Alopecurus agrestis L.
“ *geniculatus* Linn.
“ *geniculatus var. aristulatus* Munro.
Alopecurus pratensis Linn.
Amphicarpum Purshii Kth.
Andropogon provincialis Lam.
“ *scoparius* Michx.
Anthoxanthum odoratum Linn.
Apera spica-venti Beauv.
Arrhenatherum avenaceum Beauv.
(Tall Oat Grass; Evergreen Grass.)
Asprella hystrix Willd.
(Bottle Grass.)
Avena hirsuta.
“ *nuda.*
Beckmannia erucæformis Host.
Bouteloua hirsuta Lag.
“ *oligostachya* Torr.
“ *racemosa* Lag.
Brachyelytrum aristatum Beauv.
Briza maxima.
Bromus breviaristatus Thurb.
“ *brizæformis.*
“ *ciliatus* L.
“ *Kalmii* Gray.
“ *mollis* L.
“ *unioloides* Willd.
“ *secalinus* L.
(Cheat, Chess.)
Cenchrus catharticus.
(From Russia.)
Cenchrus montanus.
(From Russia.)
Cenchrus tribuloides L.
Chloris berbata.
(From Russia.)
Chrysopogon nutans Benth.
Cinna arundinacea L.
Coix lachryma L.
(Job's Tears.)
Cynodon dactylon Pers.
(Bermuda Grass.)
Cynosurus cristatus L.
(Crested Dog's Tail Grass.)
Dactylis glomerata L.
(Orchard Grass.)
Danthonia spicata Beauv.
Deschampsia cæspitosa Beauv.
“ ?
Deyeuxia Canadensis Beauv.
(Blue Joint.)
Eatonia Pennsylvanica Gr.
“ *obtusata* Gr.
Eleusine flagellifera.
“ *Indica* Gært.
Elymus arenarius L.
“ *Canadensis* Linn.
(Wild Rye; Lyme Grass.)
Elymus condensatus Presl.
(Giant Rye Grass.)
Elymus Europeus.
“ *striatus* Willd.
“ *triticoides* Nutt.
“ *Virginicus* L.
(Wild Rye.)
Elymus Virginicus var. glauca.
Eragrostis major Host.
“ *pilosa* L.
“ *pectinacea* Gray.
“ *viscosa.*
(From Russia.)
Festuca duriuscula L.
“ *elatior* L.
(Tall Fescue.)
Festuca pratensis L.
(Meadow Fescue.)
Festuca nutans Willd.
“ *ovina* L.
(Sheep's Fescue.)
Festuca ovina var. ?
“ *rubra* L.
“ *scrabrella* Torr.
“ *tenella* Willd.
Glyceria arundinacea Kth.

Glyceria Canadensis Trin.
(Rattlesnake Grass.)
Glyceria fluitans R. Br.
“ *nervata* Trin.
Graphephorum melicoides Beauv.
Holcus lanatus L.
(Velvet Grass.)
Holcus mollis L.
Hordeum jubatum L.
(Squirrel Tail Grass.)
Kœleria cristata Pers.
Leersia oryzoides Swz.
“ *Virginica* Willd.
(Cut Grass.)
Lolium perenne L.
(Rye Grass.)
Lolium perenne var. Italicum.
(Italian Rye Grass.)
Lolium temulentum L.
Milium effusum L.
Molinia cœrulea Mœnch.
Muhlenbergia diffusa Schreb.
(Nimble Will.)
Muhlenbergia glomerata Trin.
“ *Mexicana* Trin.
“ *sylvatica* T. & G.
Oryzopsis asperfolia Michx.
“ *melanocarpa* Muhl.
Panicum capillare L.
“ *clandestinum* L.
“ *crus-galli* L.
(Barnyard Grass.)
Panicum crus-galli L. *var. hispidum.*
“ *depauperatum* Muhl.
“ *dichotomum* L.
“ *glabrum* Gand.
“ *latifolium* Muhl.
“ *milliaceum* L.
(From Russia.)
Panicum sanguinale L.
(Crab Grass.)
Panicum virgatum L.
Pennisetum longistylum.
Phalaris arundinacea L.
“ “ *var. picta.*
(Cultivated.)
Phalaris arundinacea.
(Cultivated and reverted.)
Phalaris Canariensis L.
Phleum pratense L.
(Timothy.)
Poa alpina L.
“ *annua* L.
“ *arachnifera* Torr.
“ *compressa* L.
(Blue Grass.)
Poa debilis Torr.
“ *nemoralis* L.
“ *Nevadensis* Vasey.
“ *pratensis* L.
(June Grass; Ken. Blue Grass.)
Poa serotina Ehrb.
(Fowl Meadow Grass.)
Poa sylvestris Gray.
“ *trivialis* L.
Setaria glauca Beauv.
(Pigeon Grass.)
Setaria vividis Beauv.
(Green Pigeon Grass.)
Spartina cynosuroides Willd.
“ *juncea* Willd.
Sporobolus cryptandrus Gray.
“ *S. pallidus.*
(From Russia.)
Sporobolus heterolepis Gray.
Stipa spartea, Trin.
Tricuspis seslerioides Torr.
Triticum vulgare L.
(Common Wheat.)
Zizania aquatica L.
(Wild Rice; Indian Rice.)

OTHER THAN GRASSES.

Achillea millefolium L.
(Yarrow.)
Capparis herbacea.
(From Russia.)
Elionurus hirsutus.
(From Russia.)
Iseilema laxum.
(From Russia.)
Linum usitatissimum L.
(Flax.)
Medicago sativa L.
(Alfalfa; Lucerne.)
Melilotus alba Lam.
(Sweet Clover.)
Onobrychis sativa Lam.
(Sainfoin.)

Lespedeza striata.
(Japan Clover.)
Plantago lanceolata L.
Trifolium arvense L.
(Rabbit-foot Clover.)
Trifolium hybridum L.
(Alsike Clover.)
Trifolium Kingii.
Trifolium pratensis L.
(Common Clover.)
Trifolium procumbens L.
(Hop Clover.)
Trifolium medium L.
(Mammoth Clover.)
Trifolium repens.
(White, or Dutch Clover.)

THE ARBORETUM.

This was started in 1873, and from time to time has been noticed in former reports. This spring a small piece on the south side, consisting of about a third of an acre, was planted to white pines, Norway spruces and box elders, alternating, the plants in rows four feet apart. The arboretum is growing more and more interesting, and is a favorite place for many who are interested in forestry.

For most of the report regarding the experiments begun at the college, I am indebted to my assistant, Eugene Davenport, who has shown great interest in the subject and has proved himself an accurate and careful experimenter.

W. J. BEAL,
Botanist of the Station.

Agricultural College, Mich.,
June 30, 1889.

REPORT OF THE VETERINARIAN.

To the Director of the Michigan Experiment Station:

Sir—Since submitting my last report I have devoted considerable time to the study of micro-organisms, observing their development and other peculiarities. While watching the changes that occur in certain animal excretions when exposed to ordinary atmosphere, I was one day engaged making an examination of the fæces of a horse with the aid of a microscope, when I was somewhat surprised to find an exceedingly lively little creature, performing very energetic serpentine movements in the field of the instrument.

I followed the above exhibition up by making daily examinations of the excretions of the horse from which the specimen was obtained, and in nearly every instance where the examination was made, I found a variable number of immature whip-worms (oxyuris curvula), for such they proved to be. In one instance I counted thirty-four wriggling in a field only one-twentieth of an inch in diameter, showing that they might readily infest the intestines in countless millions without being observed by ocular examination, unaided by a magnifying power.

On measuring one of the little creatures, I found it to be the one-sixtieth part of an inch long, and about the one ten-thousandth part of an inch in diameter; so we see why it would be next to impossible to discover their presence in the fæces by the unaided eye.

On inquiry into the history of the horse from which these worms were obtained, I learned that it was subject to frequent attacks of a disease known as spasmodic colic, and that the attacks came on, from time to time, without any apparent cause. With this account of the animal, I told the groom to watch the horse carefully to see if it passed anything of an unusual nature along with its fæces; but was not surprised some time afterwards at being told that everything appeared to be all right, as far as the appearance of the fæces was concerned, but that once in a while, besides the colic, there was a tendency to diarrhœa. After watching this case for some months, I concluded that the enteric irritation was due to these invisible parasites, and treated the horse accordingly.

With this case before me, I concluded to examine the fæces of horses affected with colic—that is, when the symptoms are produced without any apparent cause—and have been gratified to find in those cases that I examined with the microscope all showed plainly the presence of the immature worm. I regret somewhat that I have not been able to examine the fæcal matter of a greater number of horses, but this, no doubt, will be done in course of time, as I do not intend to lose sight of what has already been brought under my notice; besides, the examination is so easily made, that I am in hopes others interested in the welfare of our equine favorites will follow it up and report their findings to this department of our station. I am aware that mature whip-worms often cause colic in horses, but it had never occurred to me, nor have I ever heard it suggested, that the immature, or microscopic creature, would produce such severe symptoms as I have seen.

The manner in which I now proceed to make the examination, is to take a small particle of the fæcal matter to be examined and place it on a slide, then drop the smallest quantity of water that will cover it on steadily, and examine under a three-fourths inch objective or first-class pocket lens; the worms, if present, will soon show themselves by their erratic movements. I have found them liveliest in fresh specimens, although they will live, even in the outside world, for some days.

With regard to the destruction of the parasites, I have not had an opportunity of experimenting very extensively; indeed, it may not be necessary, as I think they will yield to most vermifuge forms of treatment. I will add, though, that I have experienced very beneficial results from the administration of quinine and chlorate of potash. The procedure which I adopted was to give fifteen grains of sulphate of quinine mixed with two drachms of chlorate of potassium. This dose was given in the food three times a day and continued for four days.

ACTINOMYKOSIS.

During the winter months of the present year the disease known conventionally as Lumpy Jaw (*Actinomykosis*) was frequently brought under the notice of the people of Michigan, as well as other States, and as I am not aware of its ever having been investigated in this country, and as there are certain features of the disease that I am not aware have been investigated in any part of the world, I recommended to the board of conference of the Michigan Experiment Station that the veterinary department of this station be instructed to investigate this complaint, and that the investigation be directed: First, towards the cause of this disease; second, to determine if it is transmissible from animal to animal, and the circumstances that are most favorable to its transmission; third, to determine, as far as possible, what animals are most susceptible to the complaint; fourth, to determine, if possible, if the poison will grow upon grass, or other aliment when exposed to the sun's rays; fifth, to test the effect of cooking upon it, and determine what temperature it requires to destroy the poison.

With regard to the first part of this investigation, I will say that during the last few years (in our own time) transatlantic investigators have discovered a radiating fungus composed of a number of little club-shaped bodies, arranged in such a manner that they have been called *actinomyces*. These, when transmitted to other animals under favorable circumstances, are said to reproduce themselves, and thus cause *actinomykosis* in the other animal.

In carrying on this work it was my desire, first of all, to grow these *fungi* in some artificial culture medium, then transmit the artificial preparation to some animal, and watch the result; and for this purpose I procured some tumors, supposed to be composed in part of ray fungi or actinomyces, and inoculated certain culture fluids, as well as solid culture material; but up to the present time I have not been able to produce an artificial crop that would reproduce itself in another medium. I learn from experience that these microbes are not easy to grow, but trust that in the near future I will have discovered a medium that will reproduce them more rapidly, and thus facilitate further investigation in this important disease, and enable me to report more elaborately upon it ere long.

In closing this brief report, I have to express a feeling of gratitude for help rendered me by Assistant Mayo, D. V. S., who devoted much time to the details of the experimental work.

I am, sir,
Yours obediently,
E. A. A. GRANGE,
Veterinarian to the Michigan Experiment Station.

AGRICULTURAL COLLEGE.
June 30, 1889.

EXPERIMENT STATION BULLETINS.

NO. 43.—WEATHER SERVICE DEPARTMENT.

ANNUAL REPORT OF THE DIRECTOR, AND RAINFALL CHARTS OF MICHIGAN.

MICHIGAN WEATHER SERVICE,
IN CO-OPERATION WITH THE U. S. SIGNAL SERVICE,
OFFICE OF THE DIRECTOR,
Lansing, Mich., January 17, 1889.

Hon. FRANKLIN WELLS, *President State Board of Agriculture, Constantine, Michigan.*

SIR—I have the honor to submit the following report of the work of this service for the year ending December 31, 1888.

Instruments.—The instruments of the service are all in good condition, except one barometer, broken December 25, and one maximum thermometer, also broken in December.

Instruments are now in the hands of observers in all the counties, except Alger, Cheboygan, Gogebic, Iron, Missaukee, Presque Isle and Luce. Observers will be appointed and instruments will be placed in these counties as soon as volunteers can be secured.

Railway Weather Signals.—The weather signals have been regularly displayed during the year on the baggage cars of twenty-six trains of the following roads:

Detroit, Grand Haven & Milwaukee Ry.; Chicago & Grand Trunk Ry.; Port Huron & Northwestern Ry.; Michigan Central Ry.; Port Huron Division Grand Trunk Ry.; Grand Rapids & Indiana Ry.; Chicago & West Michigan Ry.; and the Pontiac, Oxford & Port Austin Ry.

This method of displaying the weather indications to the people of the State has been very satisfactory and should be extended to the other railroads of the State, as far as possible. This system was extended to as many trains during the year 1887, as the number of sets of signals would admit; there was $200 appropriated for this purpose, all of which was used in placing the 26 sets of signals on the trains, and the service could have been extended if more sets of signals had been available. I would recommend that six more sets be made for the purpose of extending this service to roads that are not as yet supplied, and will carry the signals on their trains regularly. Instead of having a special appropriation for this purpose, I would suggest that the amount for "incidental expenses" be increased slightly and the necessary amount taken from that fund.

In this connection the director takes pleasure in expressing the thanks of the service to the following managers for their hearty coöperation in having these signals regularly displayed on their trains: A. B. Atwater, General Superintendent Grand Trunk System; E. C. Brown, General Superintendent Michigan Central System; J. M. Metheany, General Superintendent Grand Rapids & Indiana Ry.; J. K. V. Agnew, General Superintendent Chicago & West Michigan Ry.; I. R. Wadsworth, General Superintendent Port Huron & Northwestern Ry.; James Houston, General Manager Pontiac, Oxford & Port Austin Ry.

Many farmers have expressed to the directors their satisfaction of the manner in which thse signals have been displayed during the year.

Weather Signals.—At the date of my last report, there were 142 stations displaying the weather signals, the number at the close of the year was 106, a decrease of 36 stations. The cause for this decrease in the number of stations is for two reasons: First, the displaymen neglect in many cases to render the monthly report required by the regulations of the service, and therefore, the "indications" were discontinued for non-compliance with the regulations. The number is being reduced so that there will be only those stations that do render this monthly report regularly; the second reason is, that when the first set of flags are worn out, it falls on one or two persons to purchase a new set where the whole town was interested in purchasing the first set, and consequently the one or two on whom this burden falls do not desire to do all that is required for the benefit of the citizens of the town where the signals are displayed.

To obviate this difficulty, I believe it would be of advantage to all, for the service to purchase the flags and thus control the display in a more satisfactory manner. This method has been adopted by the Pennsylvania service with success.

The flags could be obtained much cheaper by the quantity than by purchasing them by the single sets, and $700 would be sufficient to purchase 100 sets of signals, which number would be all that would be required during the next two years.

Voluntary Observers.—The director takes great pleasure in stating that corps of observers have accomplished more in building up this service than any other class; to them the service owes the vast amount of data that has been published during the past two years, and for the very substantial basis that the service has now attained. These observers have, as a rule, been very faithful in taking the observations and forwarding them to the central office promptly at the close of the month of which they were a record, and have greatly aided the director in proving and computing the reports for publication. When it is understood the amount of work these observers give to the service each month in taking the three observations each day and correcting them ready for use, and that these observations have to be taken every day in the month, it will be readily seen that they are entitled to a great deal of credit for the faithful performance of the work which brings them no remuneration for the time given to the work.

In this connection I would recommend that an "instrument shelter" be furnished to each of the voluntary observers, so that the shelters will all be uniform and better results be obtained thereby, and as a means of better protection to the imstruments of the service. Another important reason for this move is, that when an observer is supplied with instruments, it takes from one to two months before the observer has a shelter made so as to make a satifactory report to this office. A shelter sent with the instruments, ready to be put up, would obviate the difficulty, and would secure to the service good observers, where it is now impossible to do so, more for the reason that the observer does not understand exactly the plan for the shelter, and that he may not have the ready money to expend to construct one properly. The director believes it would be more economical in the end to furnish the shelter direct than to have the voluntary observer furnish it. The matter of paying a small amount to each observer for each monthly report has been recommended, and I believe it to be of some importance that it should be done, as a means of securing better and more continuous reports. There are on the list of the service 103 voluntary observers, and of that number 56 make a continuous report for the entire year, the remainder having omitted from one to two or more months, so that the reports had to be thrown out of the annual summary of observation. I believe that a small compensation will in a great measure obviate the difficulty. It is not recommended that the observers be paid a regular salary yet, but a sum that would, in a measure, reimburse them for the money paid out to place the station in shape for making regular reports. Some observers have paid out as much as $50 to have their station in the best possible condition for making the reports. The value of the reports of these observers should be recognized in some substantial manner, and the director believes that the one recommended would be satisfactory to the observers.

The reports of the observers are, upon receipt at the central office, carefully computed, proved and entered on the appropriate tables, for publication each month by the Secretary of State in the crop report.

There has been an average of 75 voluntary observers reporting each month during the year, and since July 1, eight of the U. S. Service. These reports contain the following data: Record of barometer, temperature, relative humidity, precipitation, wind, clouds and the state of the weather at each of the three observations.

Weather-Crop Bulletin.—This bulletin, which was inaugurated May 7, 1887, and continued during the growing season, was published each Saturday morning from March 4, to September 29. As has been stated, this bulletin in no way encroaches upon the prerogatives of the Secretary of State, but simply gives the condition of the growing crops for the past seven days, and what effect the weather has had upon them. Seventy-five copies were issued weekly, and the information given to the daily papers of the State was also published in many of the weekly papers. The information thus given placed the condition of the crops before the people every week, and has been of no little value to the agriculturists of the State. It is the intention to continue the bulletin during the coming season and enlarge somewhat the amount of information that was supplied during the past year.

Temperature Normals.—During the year the director has finished the work of compiling the mean daily temperature for each section of the State, and has had them published with the monthly reports. The work has occupied the spare time of the office force during the better part of two years, and it is with satisfaction that the director announces this work completed. These normals will allow of a comparison of the mean daily and monthly temperature of the State, and will be of great value to the people in determining the temperature of the locality in which they reside, and also in determining what trees or cereals are best adapted to their localities. These normals were used during the past season, in connection with the crop-bulletin to determine the departure each week of the mean daily temperature from the average, and the consequent effect upon the crops.

Precipitation Charts.—During the year the director has had compiled the average monthly rainfall for each section of the State, and has had the figures published in the monthly report. Believing that the information thus compiled could be better shown by being charted, the director made a chart of the State showing the average monthly rainfall for each month and for the year. These charts were made up from the observations of 13 years, and about 4,000 reports were examined and proved to obtain the data. There was also made the charts of the monthly and annual rainfall for the present year which are to accompany the normal charts. The board, at its regular meeting, December 11, authorized the director to have these charts photo-engraved. This has been done at a cost of $76.14 for the 26 charts, and they are now ready for publication. These charts will be of great value to the people of Michigan, as the rainfall can be readily compared with the normal and thus ascertain in each locality, whether the rainfall has been the average or not. In this connection the director would state that in September, 1887, he issued a circular calling for volunteers to take the daily rainfall, and in response he obtained 30 observers who have been furnishing valuable reports upon this important subject. These reports have been of the greatest service in making up these charts, as can be readily seen upon examination, and show conclusively the peculiarities of the rainfall in this State. This subject will receive the careful attention of the director during the coming year, and its close connection with the growing of crops.

Office Force—The office force consists of the director, and the assistant to the director, Mr. E. H. Nimmo. They have compiled all the vast amount of data that has come from this service during the year. I wish to recommend the work of Mr. Nimmo, who has proved a very efficient assistant, and has performed all work assigned to him with promptness and ability, and to his quick work is due, in a measure, the amount of work accomplished by the central office.

The service may be said to be now established, and if the favor with which it is received by the people is any indication of its worth, it has come to stay, and I would recommend that it be permanently established as it is now operated, under the control of the State Board of Agriculture.

In closing this report, the director desires to express his grateful appreciation of the hearty co-operation of the board, as a whole, and to the members individually, for their support has been of great value in carrying on the work of the service.

The service was established February 3, 1887, and at the close of the time for which the appropriations were made, the director believes that every pledge then made has been fulfilled.

Very respectfully, your obedient servant, N. B. CONGER,
Sergeant Signal Corps, Director.

MICHIGAN WEATHER SERVICE,
IN CO-OPERATION WITH THE U. S. SIGNAL SERVICE,
OFFICE OF THE DIRECTOR,
LANSING, MICH., *January 15, 1889.*

Hon. FRANKLIN WELLS, *President State Board of Agriculture, Constantine, Mich.:*

SIR—In compliance with the resolution of the State Board of Agriculture, adopted December 11, 1888, I have the honor to transmit to the Board the series of rainfall charts of Michigan.

These charts are as follows: Rainfall charts January to December, 1888, and the normal rainfall charts for each month of the year, and the annual rainfall for the State.

In the preparation of these charts about 4,000 monthly reports have been examined, proved and used.

The normal rainfall has been compiled from the observations of thirteen years, and extend from 1876 to 1888.

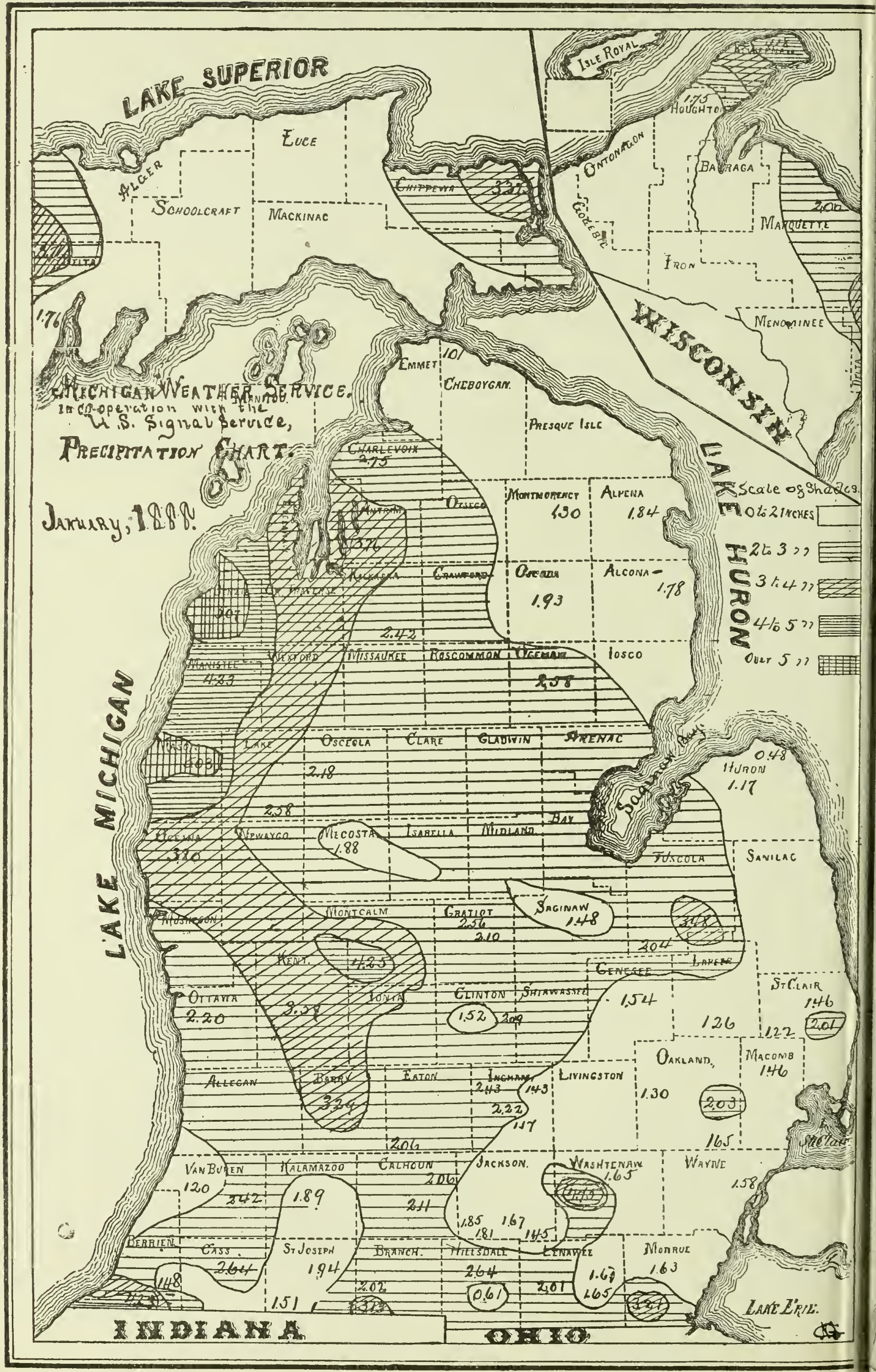
The records previous to the establishment of this service in 1887, were obtained from the files of the State Board of Health, and the director desires to state that the service is under great obligations to Dr. Henry B. Baker, Secretary of the State Board of Health, for the loan of the records for the years 1876–1886. It would have been impossible for the director to compile the normal charts if these records had not been accessible. The records which Dr. Baker has had taken have been worth 11 years' careful observations to this service.

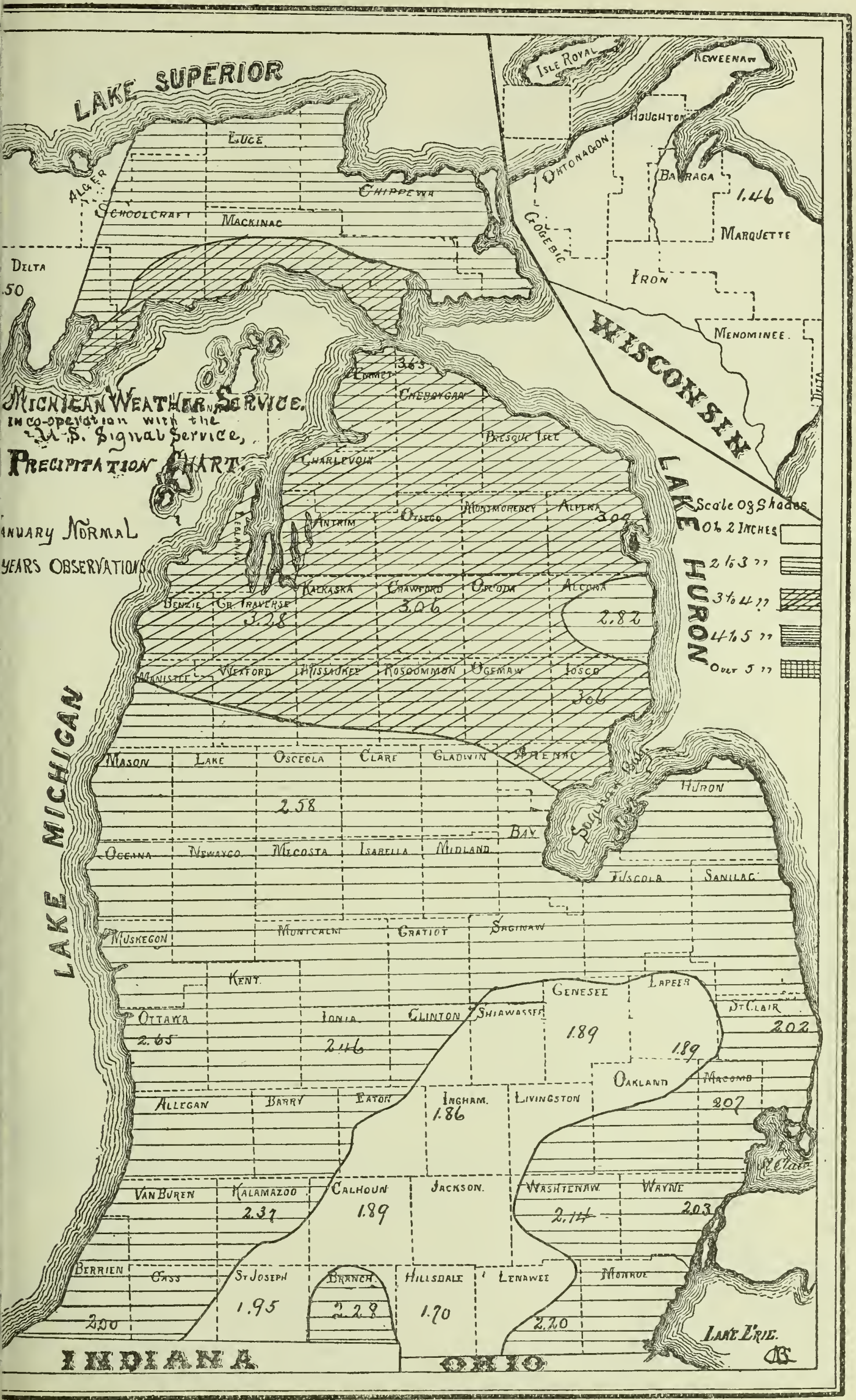
I believe that there are at present no charts of the kind in existence in Michigan, and I believe that they will be of considerable value to the agricultural and experimental interests of the State.

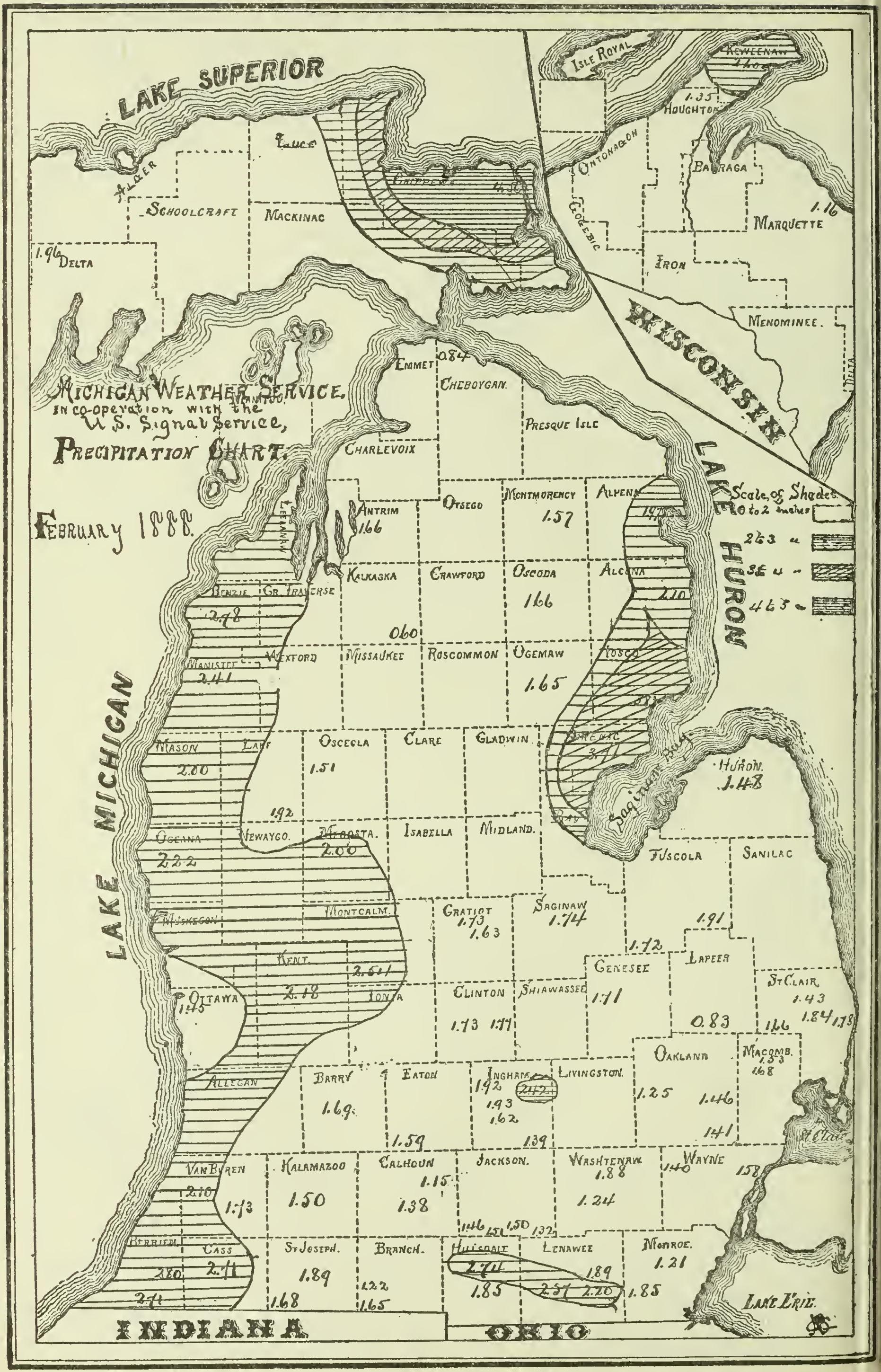
The service has been in operation now not quite two years, and in that time the director has compiled the daily normal temperatures for each section of the State and has had them published in the monthly reports of the service, and now the average monthly and yearly precipitation has been completed and charted so that it may be readily referred to, and with the monthly records of the precipitation, the condition of the staple cereals of the State may be more conveniently and surely estimated.

The data for these charts have been entirely compiled in the central office, and the charts were designed and drawn by the director. As each chart has been carefully scaled and shaded, it is not considered necessary to publish the figures from which the charts were prepared, other than are shown on each chart.

Very respectfully, your obedient servant,
N. B. CONGER,
Sergeant Signal Corps, Director.

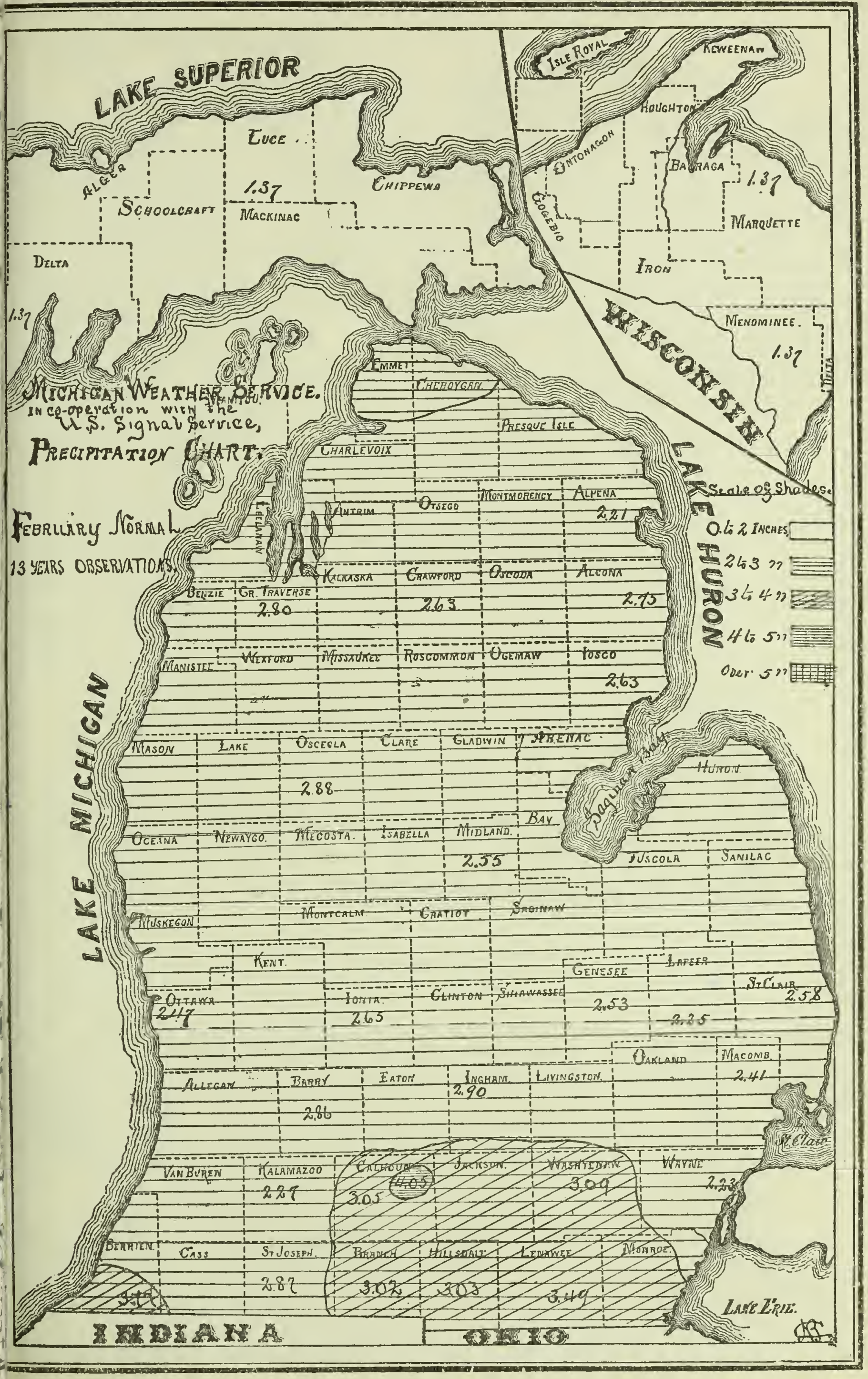

Michigan Weather Service.
In co-operation with the U.S. Signal Service,
Precipitation Chart.
January, 1888.
Scale of Shades.
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie
Saginaw Bay
Isle Royal
Alger
Luce
Schoolcraft
Mackinac
Chippewa
3.37
Delta
3.71
1.76
Ontonagon
Houghton
1.75
Baraga
Marquette
2.00
Gogebic
Iron
Menominee
Manitou
Emmet
1.01
Cheboygan
Presque Isle
Charlevoix
2.75
Antrim
3.76
Kalkaska
Grand Traverse
Benzie
5.07
Crawford
Otsego
Montmorency
1.30
Alpena
1.84
Oscoda
1.93
Alcona
1.78
2.42
Manistee
4.23
Wexford
Missaukee
Roscommon
Ogemaw
2.58
Iosco
Mason
5.08
Lake
Osceola
2.18
Clare
Gladwin
Arenac
Huron
0.48
1.17
2.58
Oceana
3.80
Newaygo
Mecosta
1.88
Isabella
Midland
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
2.56
2.10
Saginaw
1.48
3.48
2.04
Kent
4.25
Lapeer
Genesee
1.54
St Clair
1.46
2.01
Ottawa
2.20
Ionia
3.57
Clinton
1.52
2.09
Shiawassee
1.26
1.22
Oakland
1.30
Macomb
1.46
2.03
1.65
Allegan
Barry
3.29
Eaton
Ingham
2.43
1.43
2.22
1.17
Livingston
2.06
St Clair
Van Buren
1.20
2.42
Kalamazoo
1.89
Calhoun
2.06
2.11
Jackson
1.85
1.81
1.67
1.45
Washtenaw
1.65
Wayne
1.58
Berrien
1.48
Cass
2.64
St Joseph
1.94
1.51
Branch
2.02
3.13
Hillsdale
2.64
0.61
Lenawee
2.01
1.67
1.65
Monroe
1.63
3.21

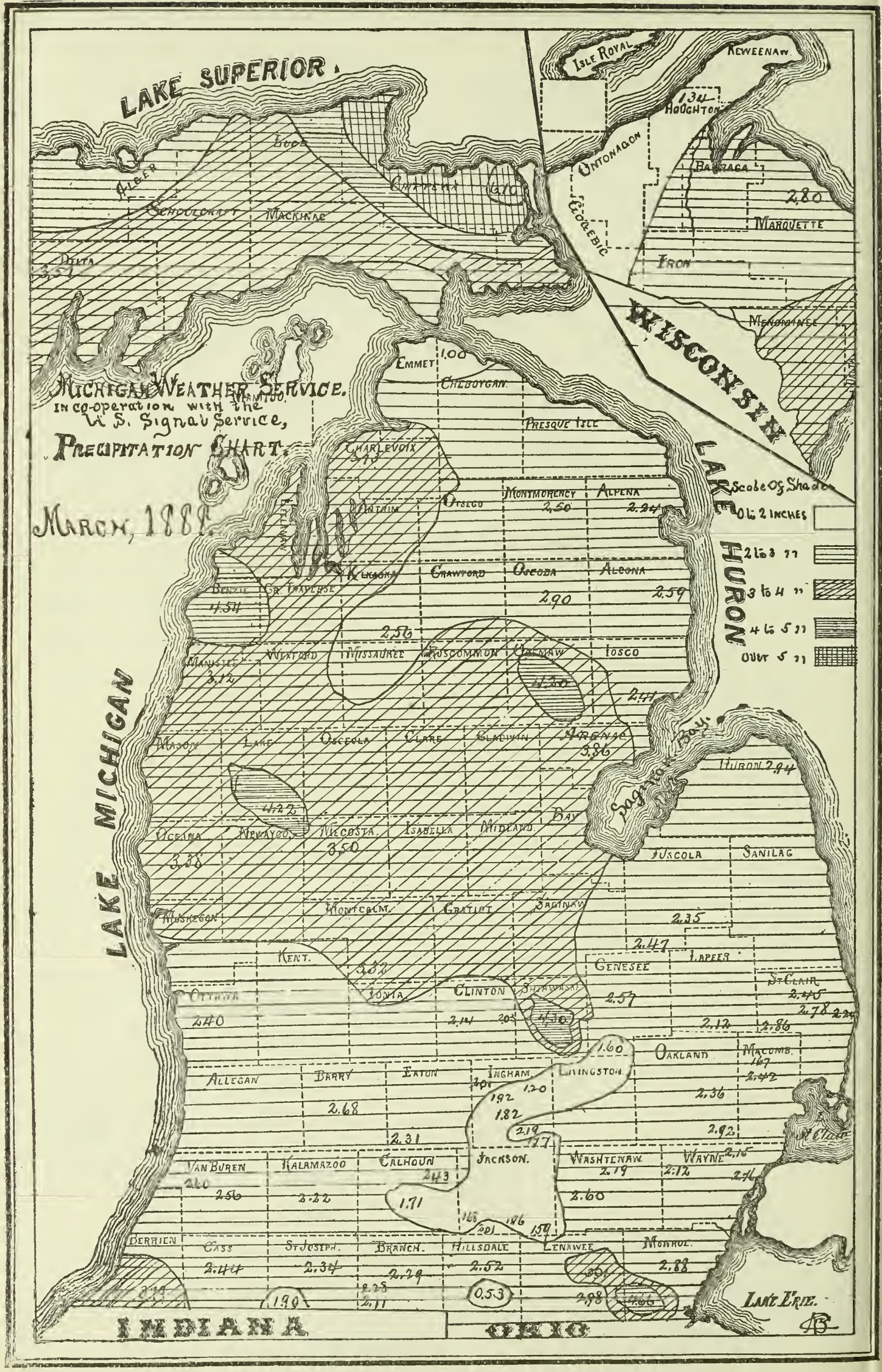

MICHIGAN WEATHER SERVICE.
In co-operation with the
U. S. Signal Service,
PRECIPITATION CHART.
anuary Normal
years Observations
Scale of Shades.
0 to 2 Inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Lake Erie.
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
1.46
Marquette
Gogebic
Iron
Menominee
Delta
Luce
Alger
Schoolcraft
Chippewa
Mackinac
Delta
.50
Emmet
3.63
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
309
Leelanaw
Benzie
Gr. Traverse
3.28
Kalkaska
Crawford
3.06
Oscoda
Alcona
2.82
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
3.06
Mason
Lake
Osceola
Clare
Gladwin
Arenac
2.58
Huron
Bay
Saginaw Bay
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Genesee
Lapeer
Ottawa
2.65
Ionia
2.46
Clinton
Shiawassee
1.89
1.89
St. Clair
2.02
Oakland
Macomb
2.07
Allegan
Barry
Eaton
Ingham.
1.86
Livingston
St. Clair
Van Buren
Kalamazoo
2.37
Calhoun
1.89
Jackson.
Washtenaw
~~2.14~~
Wayne
2.03
Berrien
2.00
Cass
St Joseph
1.95
Branch
2.28
Hillsdale
1.70
Lenawee
2.20
Monroe

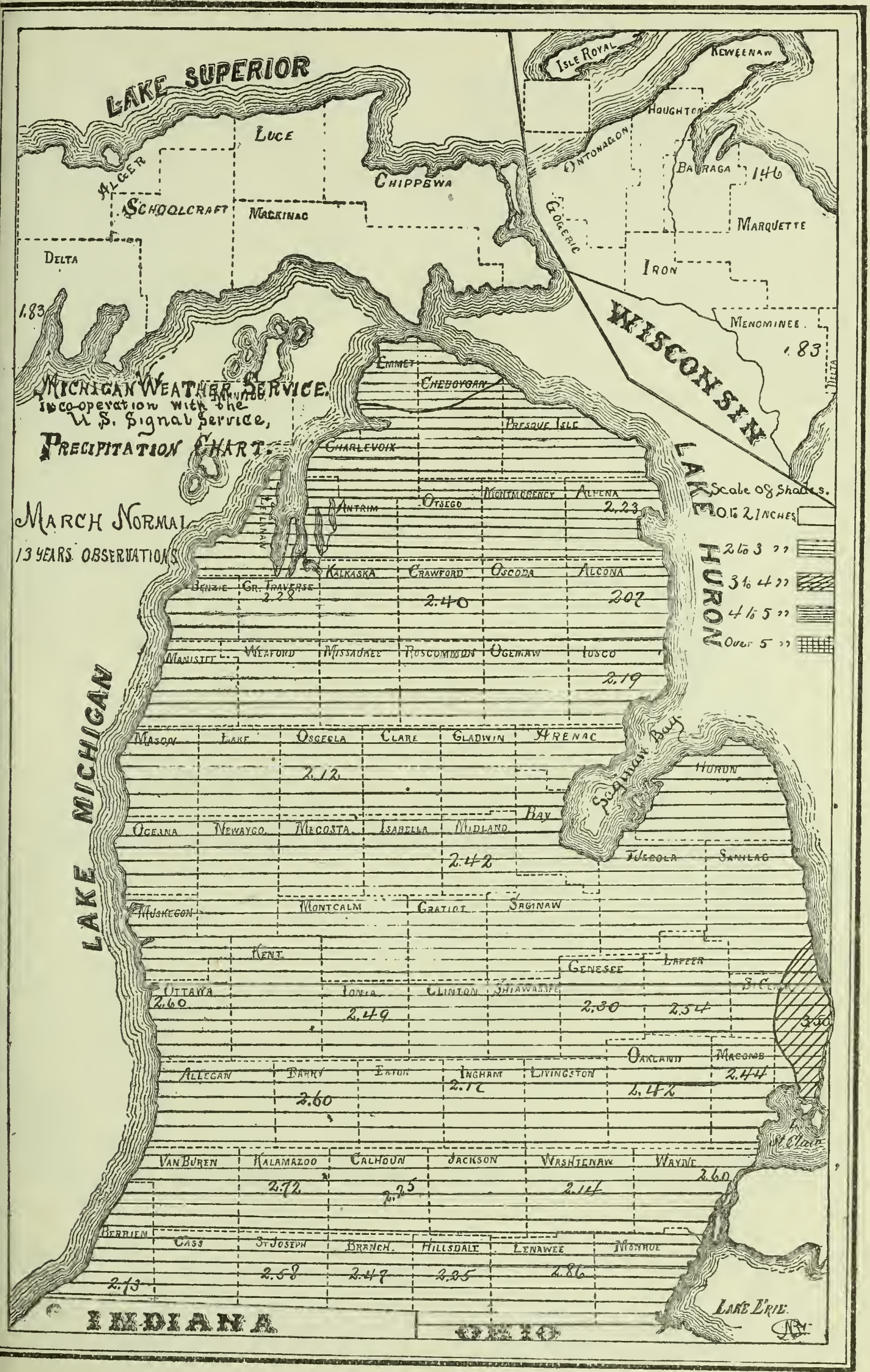


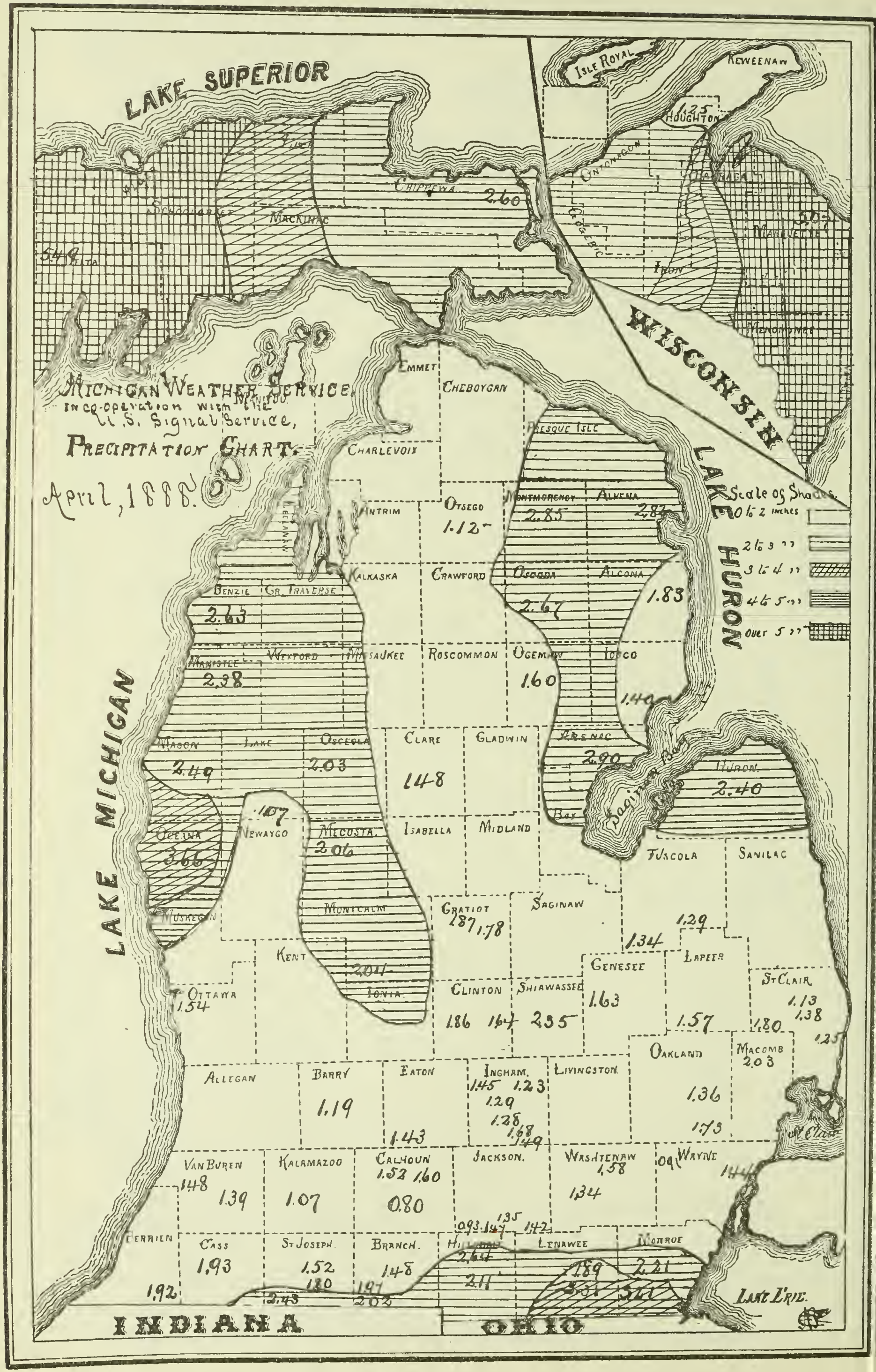
Michigan Weather Service,
in co-operation with the
U. S. Signal Service,
Precipitation Chart.

February 1888.


MICHIGAN WEATHER SERVICE.
IN co-operation with the
U.S. Signal Service,
PRECIPITATION CHART.
FEBRUARY NORMAL
13 YEARS OBSERVATIONS.
Scale of Shades.
0 to 2 INCHES,
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
ISLE ROYAL
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
1.37
MARQUETTE
GOGEBIC
IRON
MENOMINEE.
1.37
DELTA
WISCONSIN
ALGER
LUCE
1.37
SCHOOLCRAFT
MACKINAC
CHIPPEWA
DELTA
1.37
MANITOU.
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
LEELANAW
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
2.21
LAKE HURON
BENZIE
GR. TRAVERSE
2.80
KALKASKA
CRAWFORD
2.63
OSCODA
ALCONA
2.75
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
2.63
MASON
LAKE
OSCEOLA
2.88
CLARE
GLADWIN
ARENAC
HURON
Saginaw Bay
BAY
OCEANA
NEWAYGO.
MECOSTA.
ISABELLA
MIDLAND.
2.55
TUSCOLA
SANILAC
LAKE MICHIGAN
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT.
LAPEER
GENESEE
2.53
2.25
ST CLAIR
2.58
OTTAWA
2.17
IONIA
2.65
CLINTON
SHIAWASSEE
OAKLAND
MACOMB.
2.41
ALLEGAN
BARRY
2.86
EATON
INGHAM.
2.90
LIVINGSTON.
St. Clair
VAN BUREN
KALAMAZOO
2.27
CALHOUN
4.05
3.05
JACKSON.
WASHTENAW
3.09
WAYNE
2.23
BERRIEN.
3.11
CASS
ST JOSEPH.
2.87
BRANCH
3.02
HILLSDALE
3.03
LENAWEE
3.49
MONROE.
LAKE ERIE.
INDIANA
OHIO


MICHIGAN WEATHER SERVICE.
IN CO-OPERATION WITH THE
U. S. Signal Service,
PRECIPITATION CHART.
MARCH, 1889.
Scale of Shades
0 to 2 INCHES ☐
2 to 3 " ▤
3 to 4 " ▨
4 to 5 " ▥
Over 5 " ▦
LAKE SUPERIOR
ISLE ROYAL
KEWEENAW
HOUGHTON
1.34
ONTONAGON
GOGEBIC
BARAGA
MARQUETTE
2.80
IRON
MENOMINEE
WISCONSIN
ALGER
LUCE
SCHOOLCRAFT
MACKINAC
CHIPPEWA
4.10
DELTA
3.51
MANITOU
EMMET
1.00
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
3.75
ANTRIM
OTSEGO
MONTMORENCY
2.50
ALPENA
2.24
LEELANAW
KALKASKA
CRAWFORD
OSCODA
ALCONA
2.90
2.59
BENZIE
4.54
GR. TRAVERSE
2.56
MANISTEE
3.12
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
4.20
IOSCO
2.41
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
3.86
LAKE HURON
Saginaw Bay
HURON 2.94
4.22
OCEANA
3.35
NEWAYGO
MECOSTA
3.50
ISABELLA
MIDLAND
BAY
TUSCOLA
SANILAC
LAKE MICHIGAN
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
2.35
2.47
KENT
3.32
IONIA
CLINTON
SHIAWASSEE
GENESEE
2.57
LAPEER
ST. CLAIR
2.45
2.78
2.20
OTTAWA
2.40
2.14
2.03
4.30
2.12
2.86
1.60
OAKLAND
MACOMB
1.67
2.42
ALLEGAN
BARRY
2.68
EATON
INGHAM
2.01
1.20
1.92
1.82
LIVINGSTON
2.36
2.19
1.77
2.92
2.31
VAN BUREN
2.60
2.56
KALAMAZOO
2.22
CALHOUN
2.43
1.71
JACKSON
1.66
2.01
1.76
1.59
WASHTENAW
2.19
2.60
WAYNE
2.12
2.15
2.71
St. Clair
BERRIEN
3.14
CASS
2.44
ST. JOSEPH
2.34
1.99
BRANCH
2.29
2.25
2.11
HILLSDALE
2.52
0.53
LENAWEE
3.01
2.98
4.06
MONROE
2.88
LAKE ERIE
INDIANA
OHIO
AB

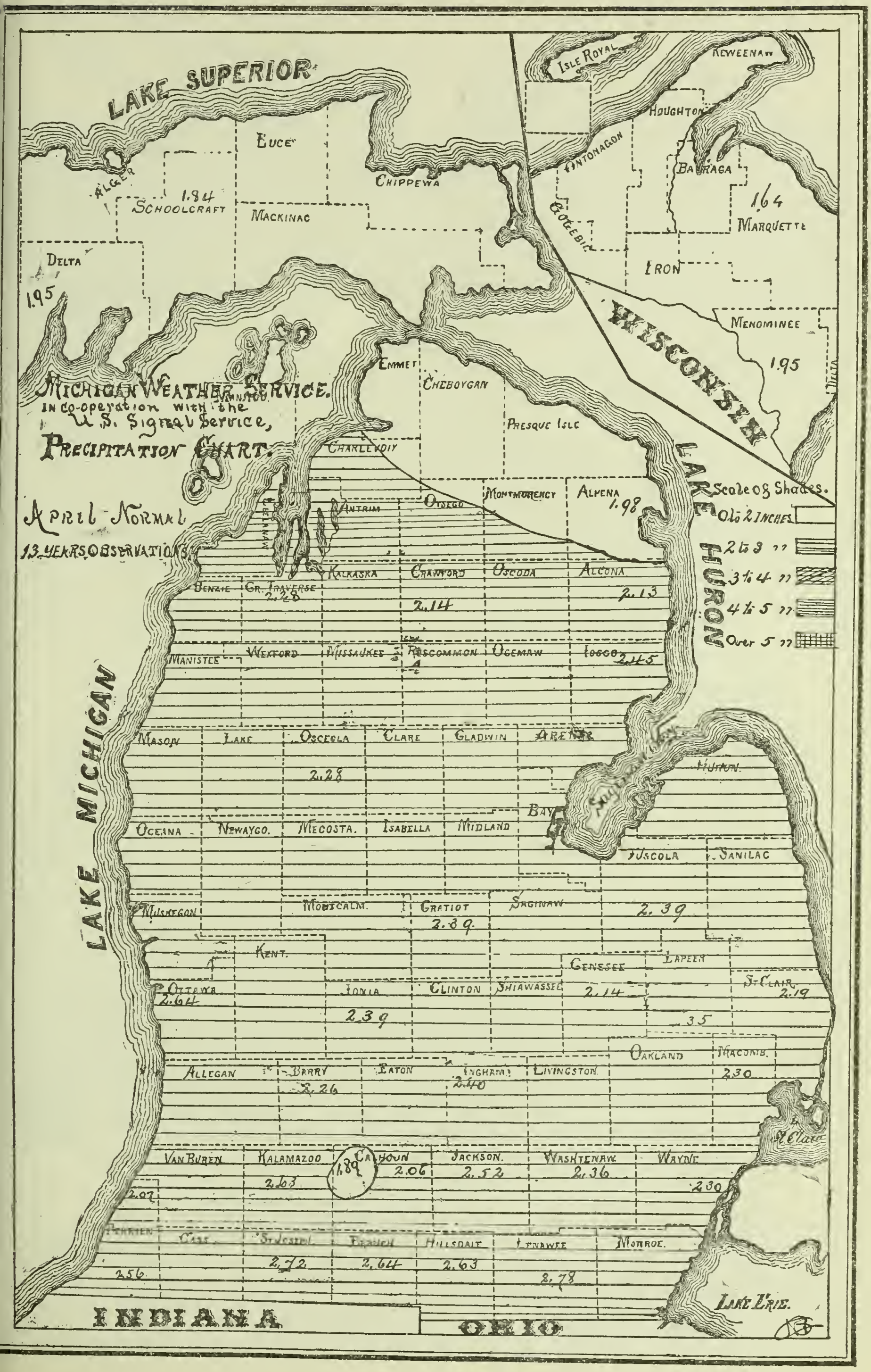

MICHIGAN WEATHER SERVICE.
In co-operation with the U.S. Signal Service,
PRECIPITATION CHART.
MARCH NORMAL
13 YEARS' OBSERVATIONS
Scale of Shades.
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Saginaw Bay
Lake Erie
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
1.46
Marquette
Gogebic
Iron
Menominee
1.83
Delta
1.83
Alger
Luce
Chippewa
Schoolcraft
Mackinac
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
2.23
Leelanau
Benzie
Gr. Traverse
2.28
Kalkaska
Crawford
2.40
Oscoda
Alcona
2.07
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
2.19
Mason
Lake
Osceola
2.12
Clare
Gladwin
Arenac
Huron
Bay
Oceana
Newaygo
Mecosta
Isabella
Midland
2.42
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Genesee
2.30
Lapeer
2.54
St. Clair
3.50
Ottawa
2.60
Ionia
2.49
Clinton
Shiawassee
Oakland
2.42
Macomb
2.44
Allegan
Barry
2.60
Eaton
Ingham
2.12
Livingston
St. Clair
Van Buren
Kalamazoo
2.72
Calhoun
2.25
Jackson
Washtenaw
2.14
Wayne
2.60
Berrien
2.13
Cass
St. Joseph
2.58
Branch
2.47
Hillsdale
2.25
Lenawee
2.86
Monroe

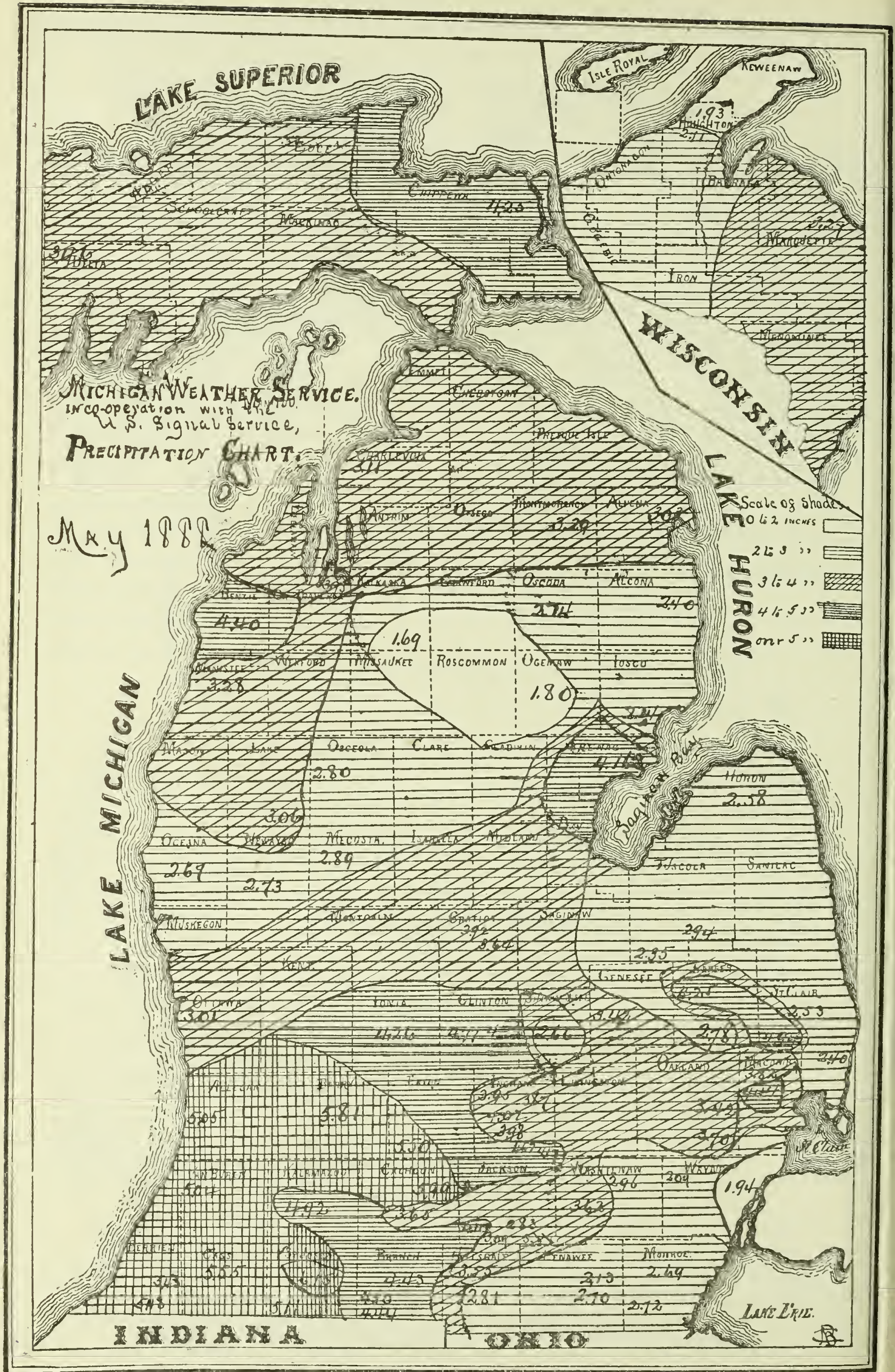


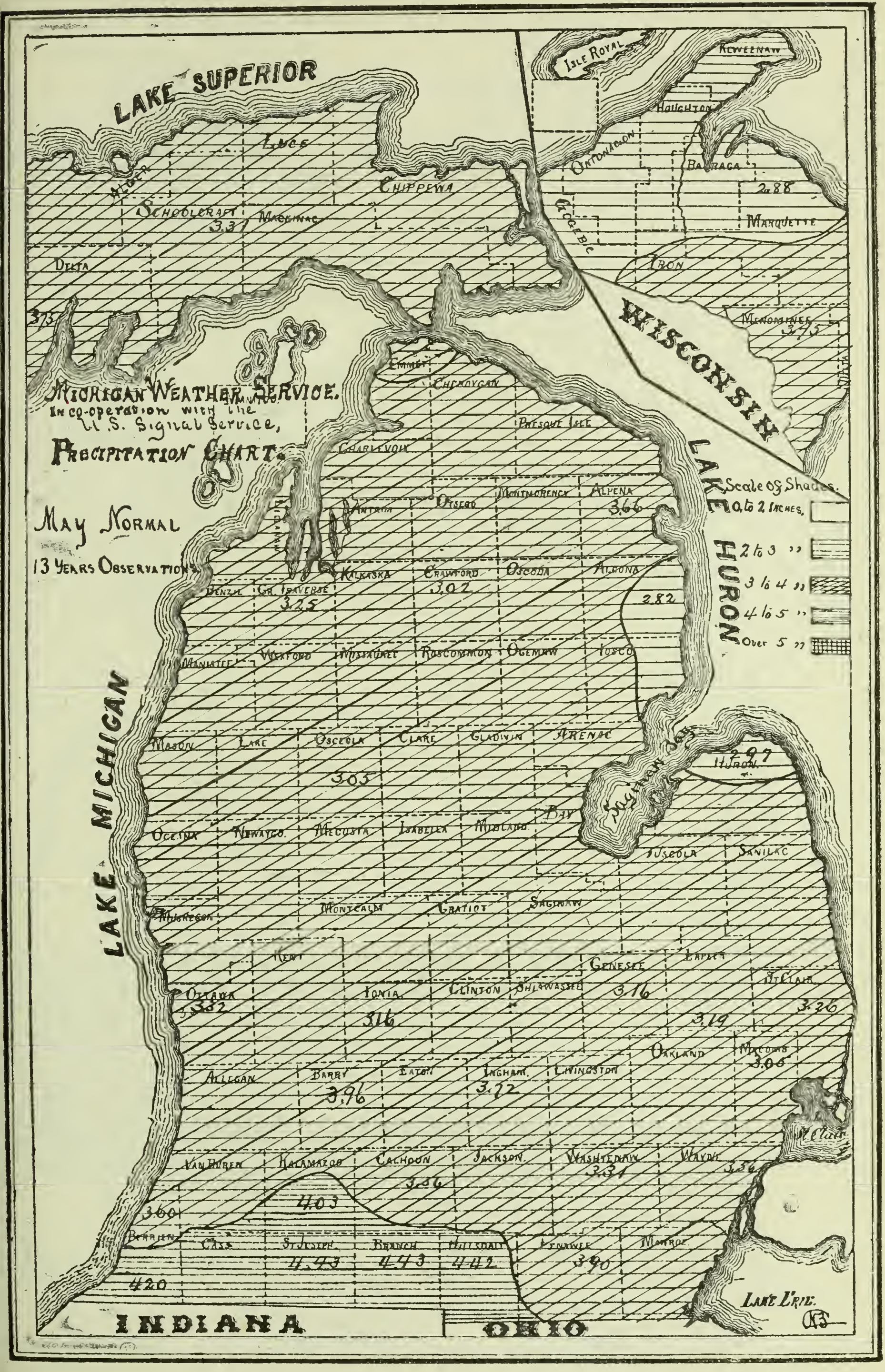
Michigan Weather Service, in co-operation with the U. S. Signal Service,

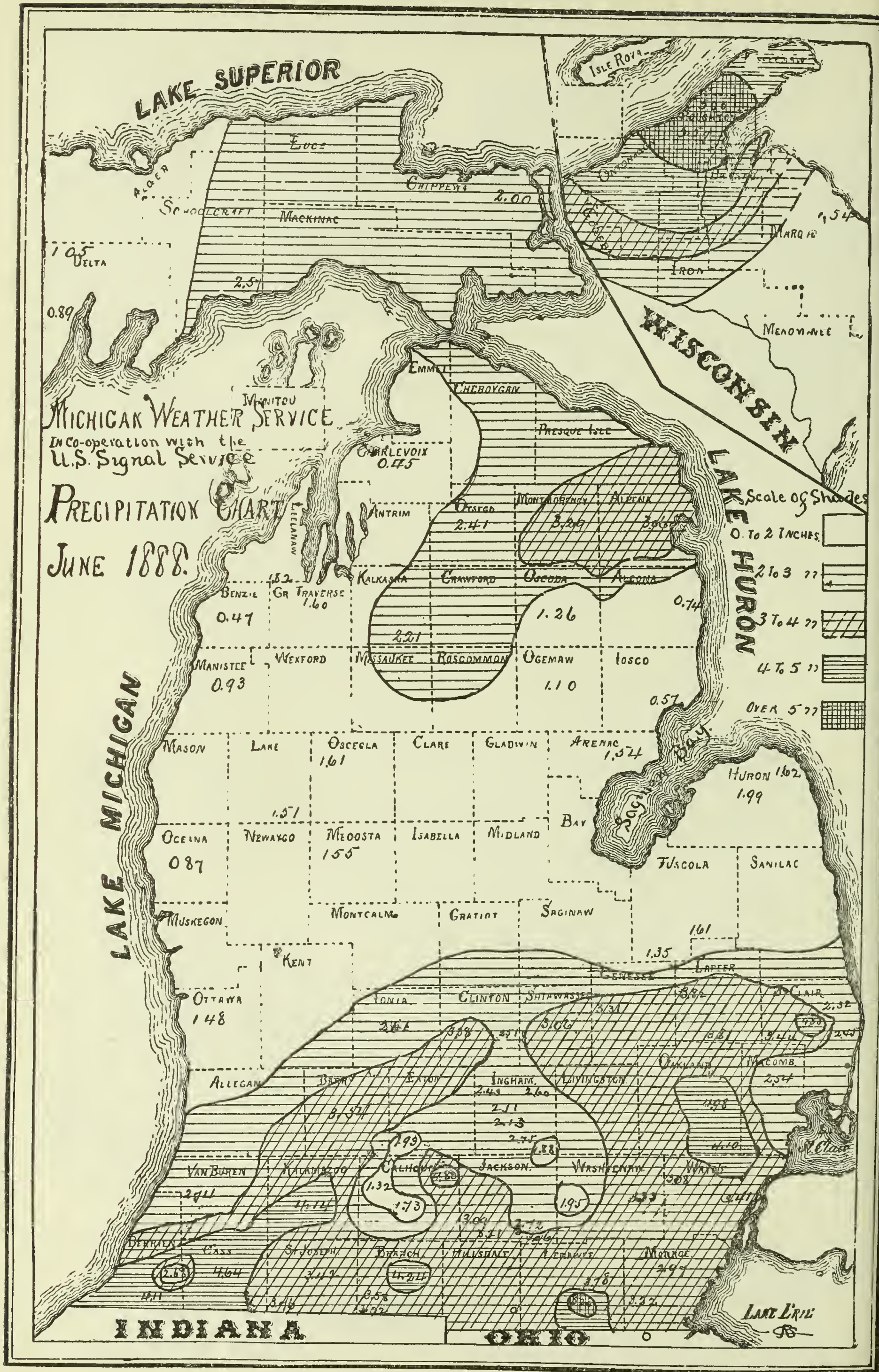
Precipitation Chart.

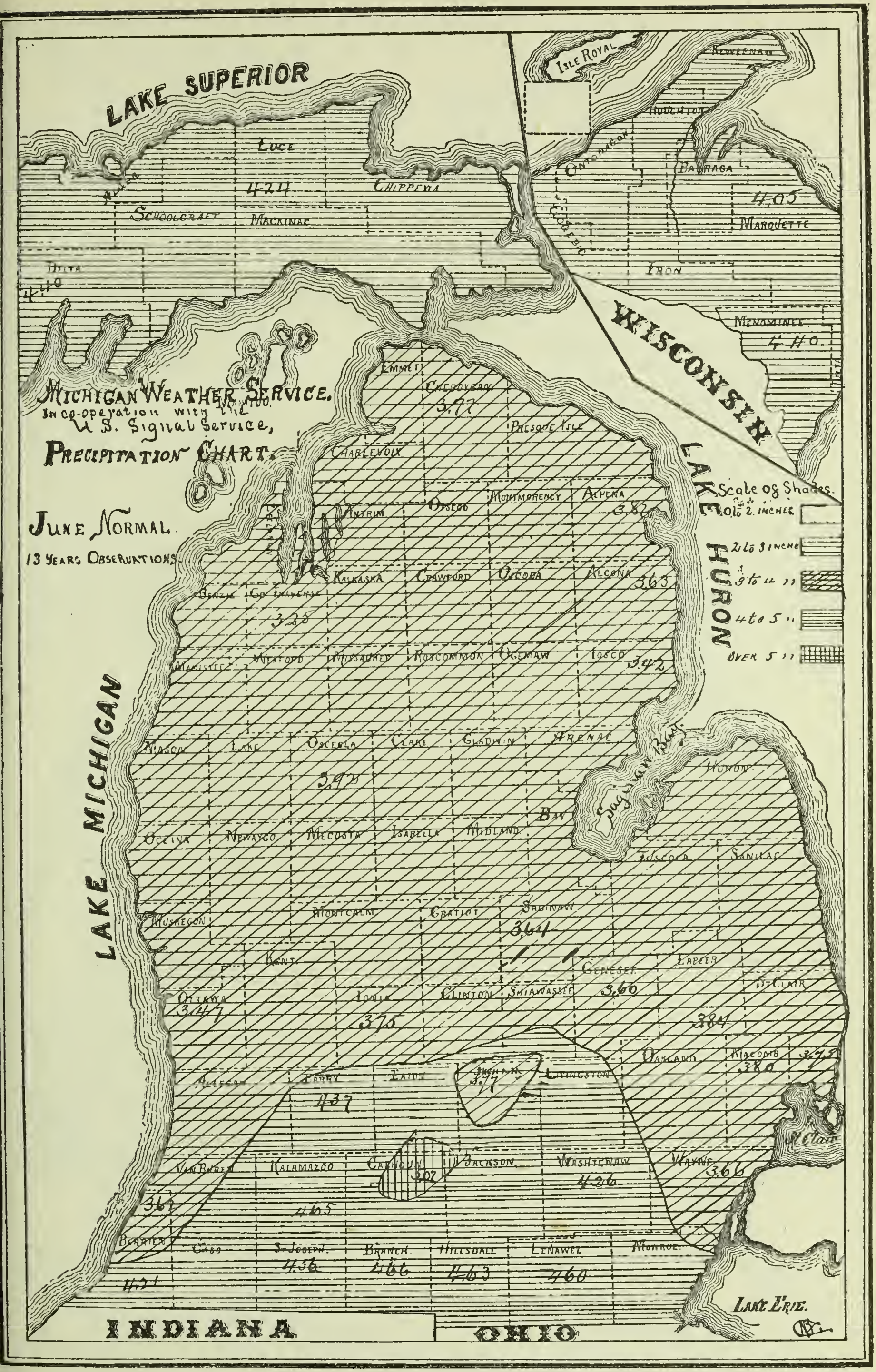
April, 1888.

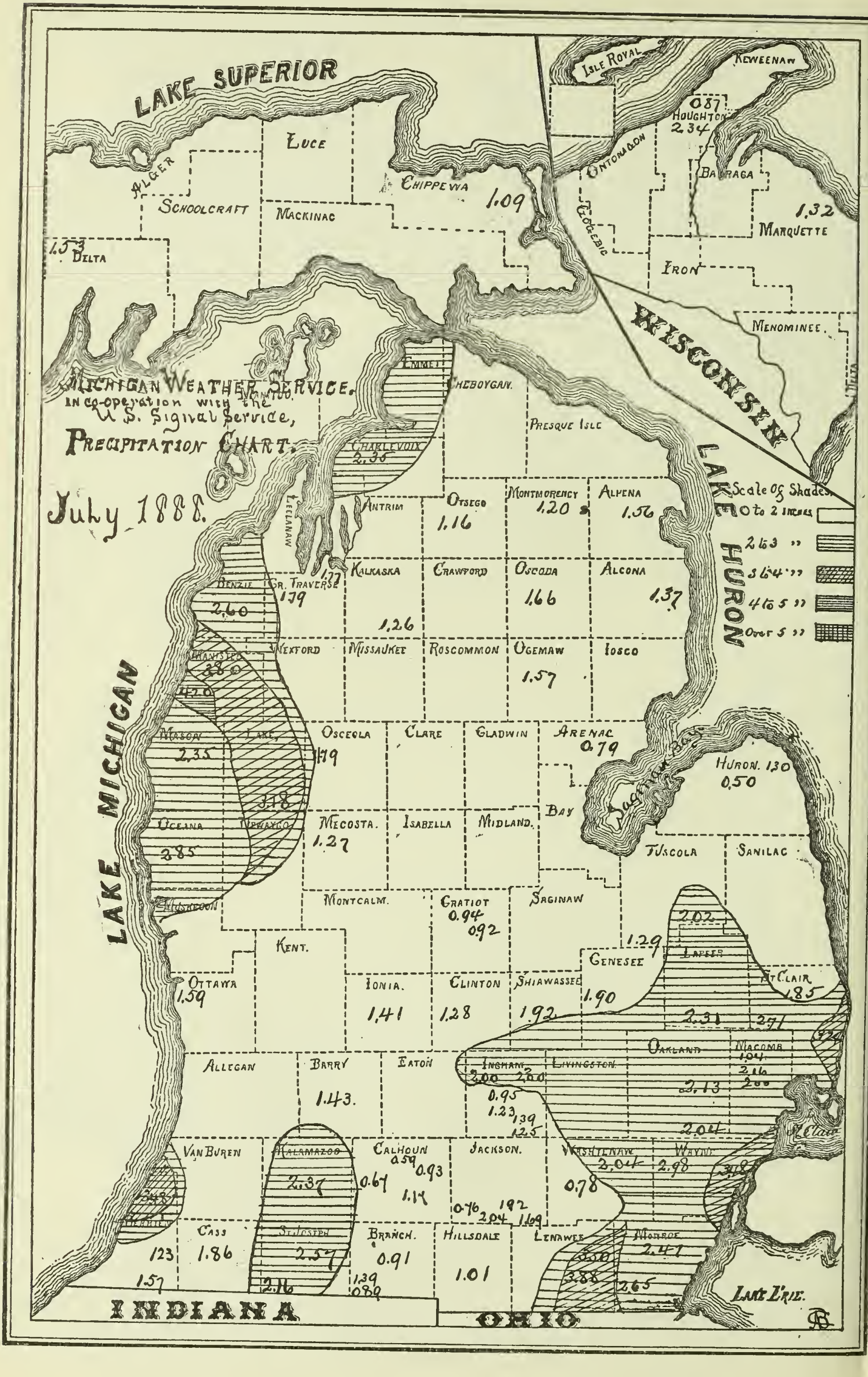

Michigan Weather Service.
In co-operation with the U.S. Signal Service,
Precipitation Chart.
April Normal
13 Years Observations.
Scale of Shades.
0 to 2 inches
2 to 3 "
3½ to 4 "
4½ to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE.
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
Baraga
Ontonagon
Gogebic
Marquette
1.64
Iron
Menominee
1.95
Delta
1.95
Alger
Schoolcraft
1.84
Luce
Mackinac
Chippewa
Emmet
Cheboygan
Presque Isle
Charlevoix
Otsego
Montmorency
Alpena
1.98
Antrim
Leelanaw
Kalkaska
Crawford
Oscoda
Alcona
2.13
Benzie
Gr. Traverse
2.20
2.14
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
2.45
Mason
Lake
Osceola
2.28
Clare
Gladwin
Arenac
Huron
Bay
Oceana
Newaygo.
Mecosta.
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm.
Gratiot
2.39
Saginaw
2.39
Kent.
Genesee
2.14
Lapeer
St. Clair
2.19
Ottawa
2.64
Ionia
2.39
Clinton
Shiawassee
.35
Oakland
Macomb.
2.30
Allegan
Barry
2.26
Eaton
Ingham
2.40
Livingston
St. Clair
Van Buren
Kalamazoo
2.63
1.89
Calhoun
2.06
Jackson.
2.52
Washtenaw
2.36
Wayne
2.30
2.07
Berrien
2.56
Cass.
St. Joseph
2.72
Branch
2.64
Hillsdale
2.63
Lenawee
2.78
Monroe.

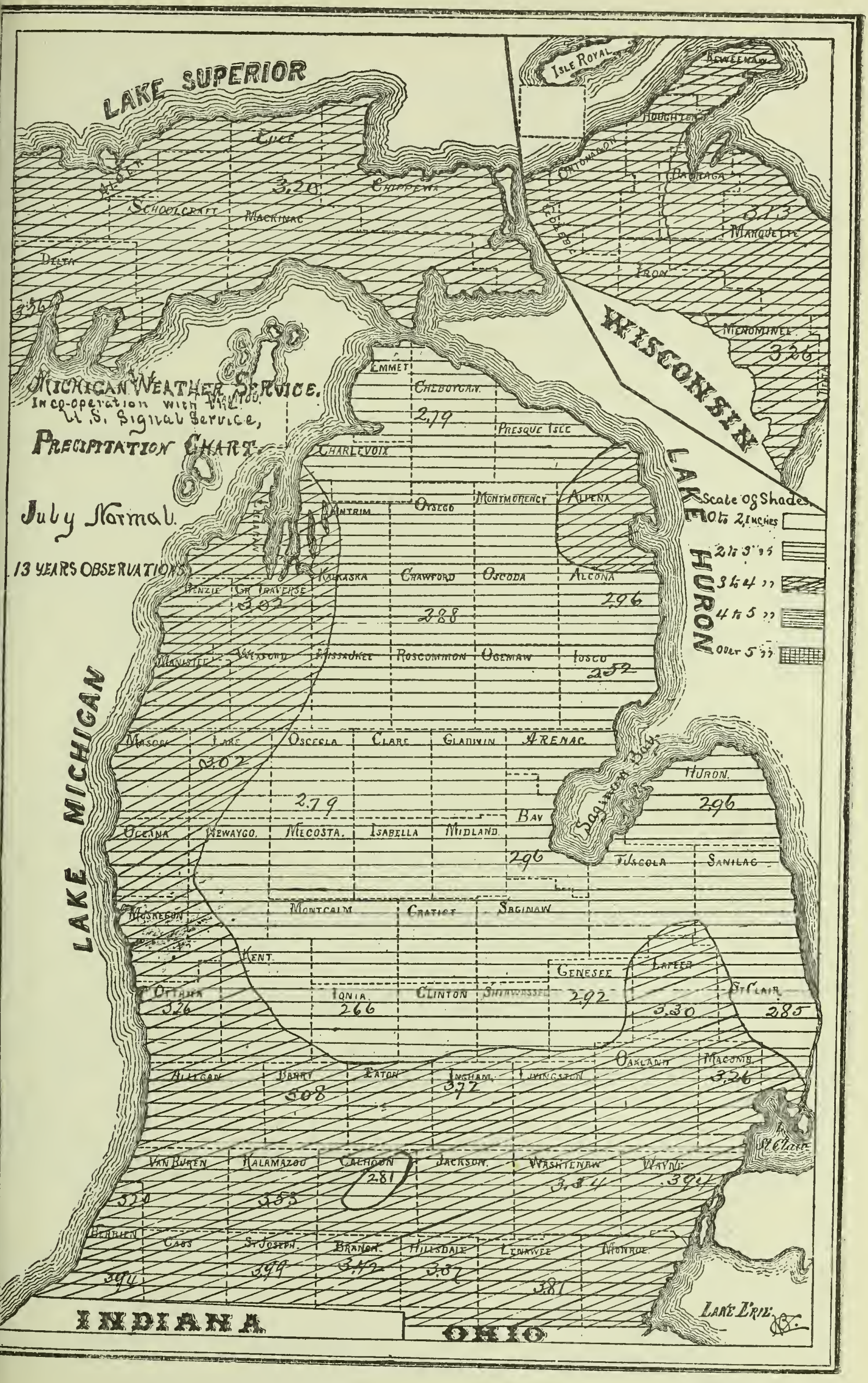

LAKE SUPERIOR
ISLE ROYAL
KEWEENAW
1.93
HOUGHTON
2.11
ONTONAGON
BARAGA
MARQUETTE
GOGEBIC
IRON
MENOMINEE
WISCONSIN
ALGER
LUCE
SCHOOLCRAFT
MACKINAC
CHIPPEWA
4.23
3.06
DELTA
MICHIGAN WEATHER SERVICE.
in co-operation with the U. S. Signal Service,
PRECIPITATION CHART.
May 1888
Scale of shades
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
over 5 "
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
3.11
ANTRIM
OTSEGO
MONTMORENCY
3.29
ALPENA
3.05
LEELANAU
BENZIE
KALKASKA
CRAWFORD
OSCODA
ALCONA
4.40
2.74
2.40
MANISTEE
3.28
WEXFORD
MISSAUKEE
1.69
ROSCOMMON
OGEMAW
1.80
IOSCO
3.41
MASON
LAKE
OSCEOLA
2.80
CLARE
GLADWIN
ARENAC
4.15
HURON
2.58
SAGINAW BAY
3.06
OCEANA
NEWAYGO
MECOSTA
2.89
ISABELLA
MIDLAND
BAY
2.69
2.73
TUSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
2.92
3.64
SAGINAW
2.94
2.95
KENT
GENESEE
LAPEER
OTTAWA
3.01
IONIA
CLINTON
SHIAWASSEE
3.14
4.26
2.66
2.78
ST. CLAIR
2.53
OAKLAND
MACOMB
2.40
ALLEGAN
5.05
BARRY
5.81
EATON
INGHAM
3.95
LIVINGSTON
3.87
3.02
3.98
3.50
3.70
VAN BUREN
5.04
KALAMAZOO
CALHOUN
4.92
JACKSON
WASHTENAW
2.96
WAYNE
2.04
1.94
St. Clair
3.62
BERRIEN
CASS
5.55
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
2.49
2.13
2.10
2.81
2.12
LAKE ERIE.
LAKE HURON
LAKE MICHIGAN
INDIANA
OHIO

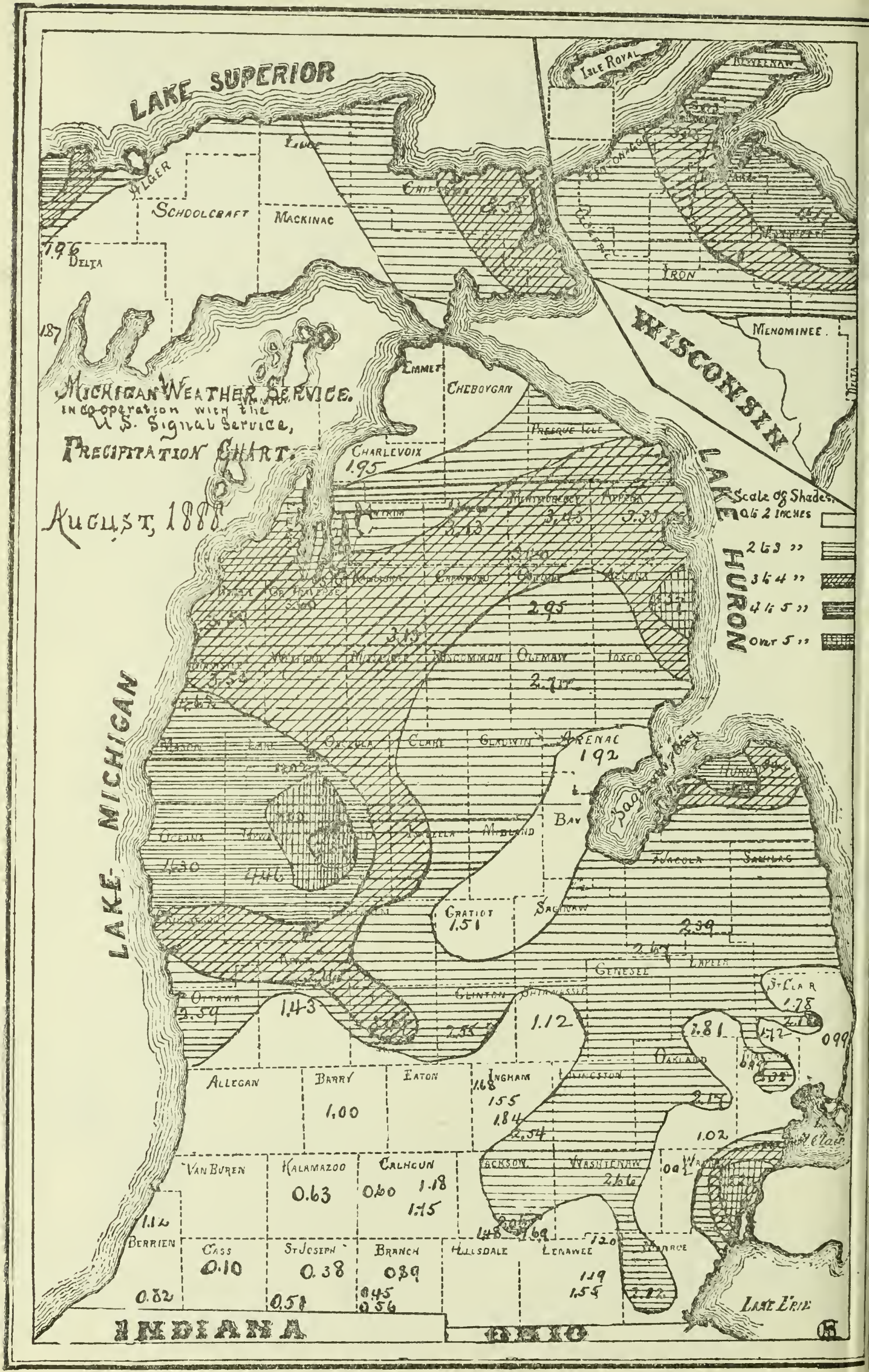

MICHIGAN WEATHER SERVICE.
In co-operation with the
U. S. Signal Service,
PRECIPITATION CHART.
May Normal
13 Years Observations
Scale of Shades.
0 to 2 Inches.
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie.
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
2.88
Marquette
Gogebic
Iron
Menominee
3.75
Luce
Alger
Chippewa
Schoolcraft
3.31
Mackinac
Delta
3.75
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
3.66
Leelanaw
Benzie
Gr. Traverse
3.25
Kalkaska
Crawford
3.02
Oscoda
Alcona
2.82
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Mason
Lake
Osceola
3.05
Clare
Gladwin
Arenac
Huron
2.97
Saginaw Bay
Bay
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Genesee
3.16
Lapeer
St. Clair
3.26
Ottawa
3.32
Ionia
3.16
Clinton
Shiawassee
3.19
Oakland
Macomb
3.06
Allegan
Barry
3.96
Eaton
Ingham
3.72
Livingston
St. Clair
Van Buren
Kalamazoo
Calhoun
3.36
Jackson
Washtenaw
3.31
Wayne
3.56
3.60
4.03
Berrien
Cass
St. Joseph
4.43
Branch
4.43
Hillsdale
4.42
Lenawee
3.90
Monroe
4.20

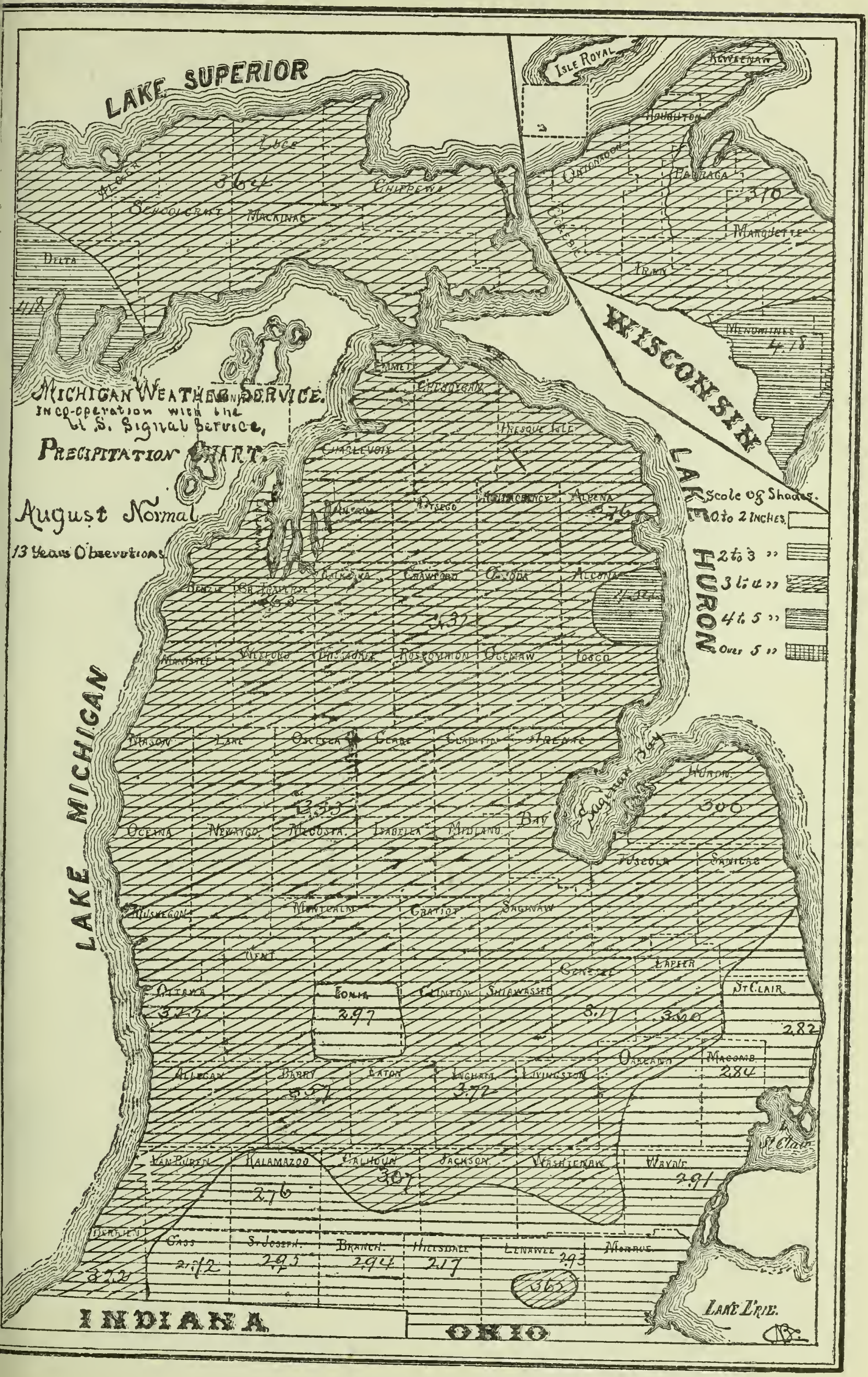

Michigan Weather Service
In Co-operation with the U.S. Signal Service
Precipitation Chart
June 1888.
Scale of Shades
0. to 2 inches.
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Saginaw Bay
Lake Erie
WISCONSIN
INDIANA
OHIO
Isle Royal
Houghton
Ontonagon
Baraga
Gogebic
Iron
Marquette
Menominee
Alger
Luce
Chippewa
Schoolcraft
Mackinac
Delta
1.05
0.89
2.00
2.5
1.54
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
0.45
Leelanaw
Antrim
Otsego
2.41
Montmorency
3.26
Alpena
Kalkaska
Crawford
Oscoda
Alcona
Benzie
0.47
Gr Traverse
1.82
1.60
2.21
1.26
0.74
Manistee
0.93
Wexford
Missaukee
Roscommon
Ogemaw
1.10
Iosco
0.57
Mason
Lake
Osceola
1.61
Clare
Gladwin
Arenac
1.54
Huron
1.62
1.99
1.51
Oceana
0.87
Newaygo
Mecosta
1.55
Isabella
Midland
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
1.61
1.35
Kent
Genesee
Lapeer
Ottawa
1.48
Ionia
Clinton
Shiawassee
St Clair
2.32
3.31
3.06
3.82
4.50
2.45
Allegan
Barry
Eaton
Ingham
Livingston
Oakland
Macomb
2.54
3.47
2.43
2.60
2.11
2.13
2.75
1.93
1.88
4.98
4.10
Van Buren
2.11
Kalamazoo
Calhoun
Jackson
Washtenaw
Wayne
1.32
1.73
1.95
3.08
St Clair
Berrien
2.68
Cass
4.64
4.11
St Joseph
Branch
Hillsdale
Lenawee
Monroe
4.24
2.78
3.16
3.58

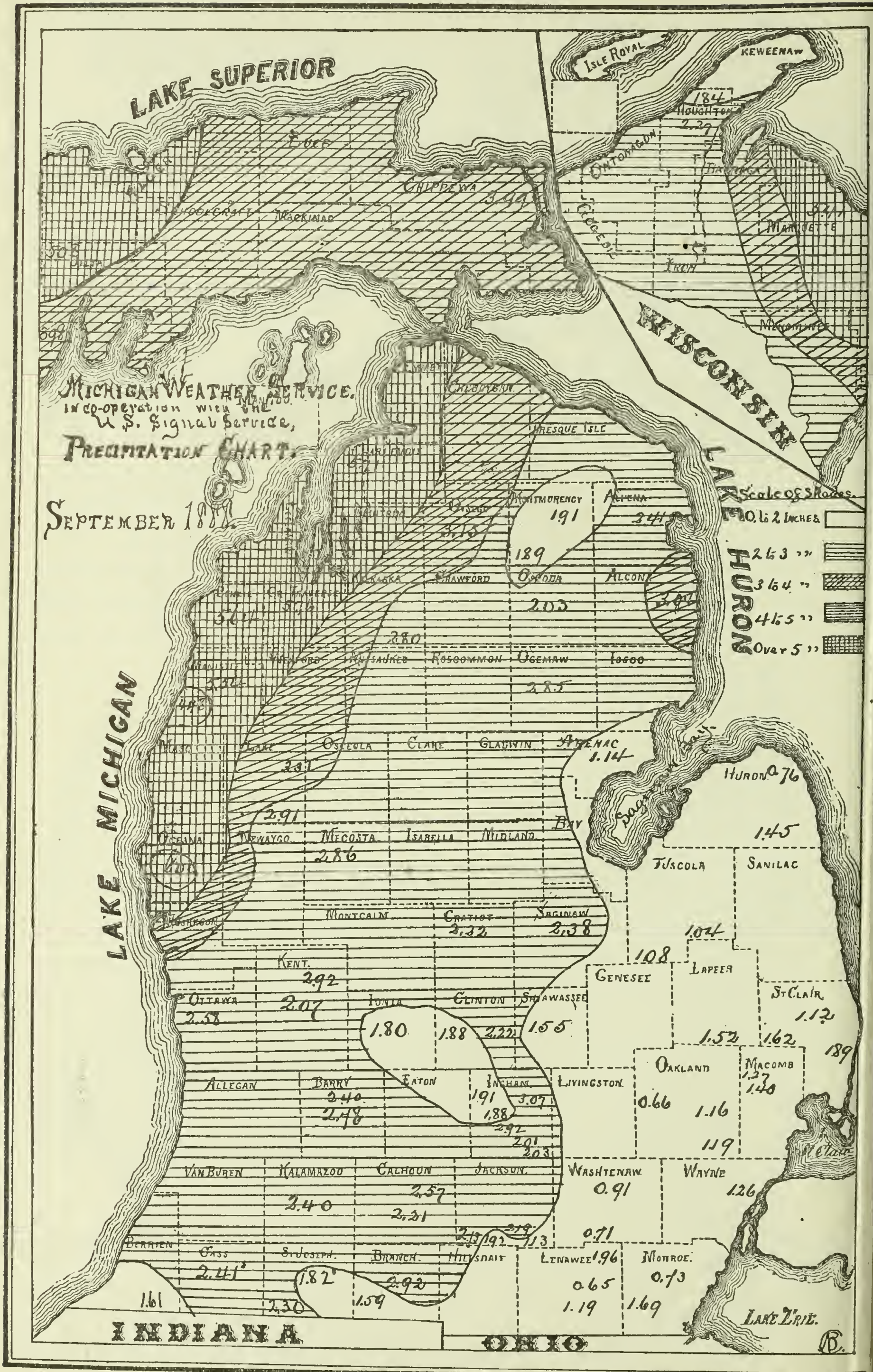

MICHIGAN WEATHER SERVICE.
In co-operation with the
U. S. Signal Service,
PRECIPITATION CHART.
JUNE NORMAL
13 YEARS OBSERVATIONS
Scale of Shades.
0 to 2. INCHES
2 to 3 INCHES
3 to 4 ,,
4 to 5 ,,
OVER 5 ,,
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
LAKE ERIE.
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
4.05
Marquette
Gogebic
Iron
Menominee
4.10
Luce
4.24
Chippewa
Schoolcraft
Mackinac
Delta
4.40
Manitou.
Emmet
Cheboygan
3.77
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
3.82
Kalkaska
Crawford
Oscoda
Alcona
3.63
Benzie
Gd Traverse
3.28
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
3.42
Mason
Lake
Osceola
Clare
Gladwin
Arenac
3.93
Huron
Saginaw Bay
Bay
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
3.64
Kent
Genesee
3.60
Lapeer
Ottawa
3.47
Ionia
3.75
Clinton
Shiawassee
St Clair
3.84
Oakland
Macomb
3.80
3.75
Allegan
Barry
4.37
Eaton
Ingham
3.77
Livingston
St Clair
Van Buren
Kalamazoo
Calhoun
5.02
Jackson
Washtenaw
4.26
Wayne
3.66
3.67
4.65
Berrien
Cass
St Joseph
4.36
Branch
4.66
Hillsdale
4.63
Lenawee
4.60
Monroe
4.21

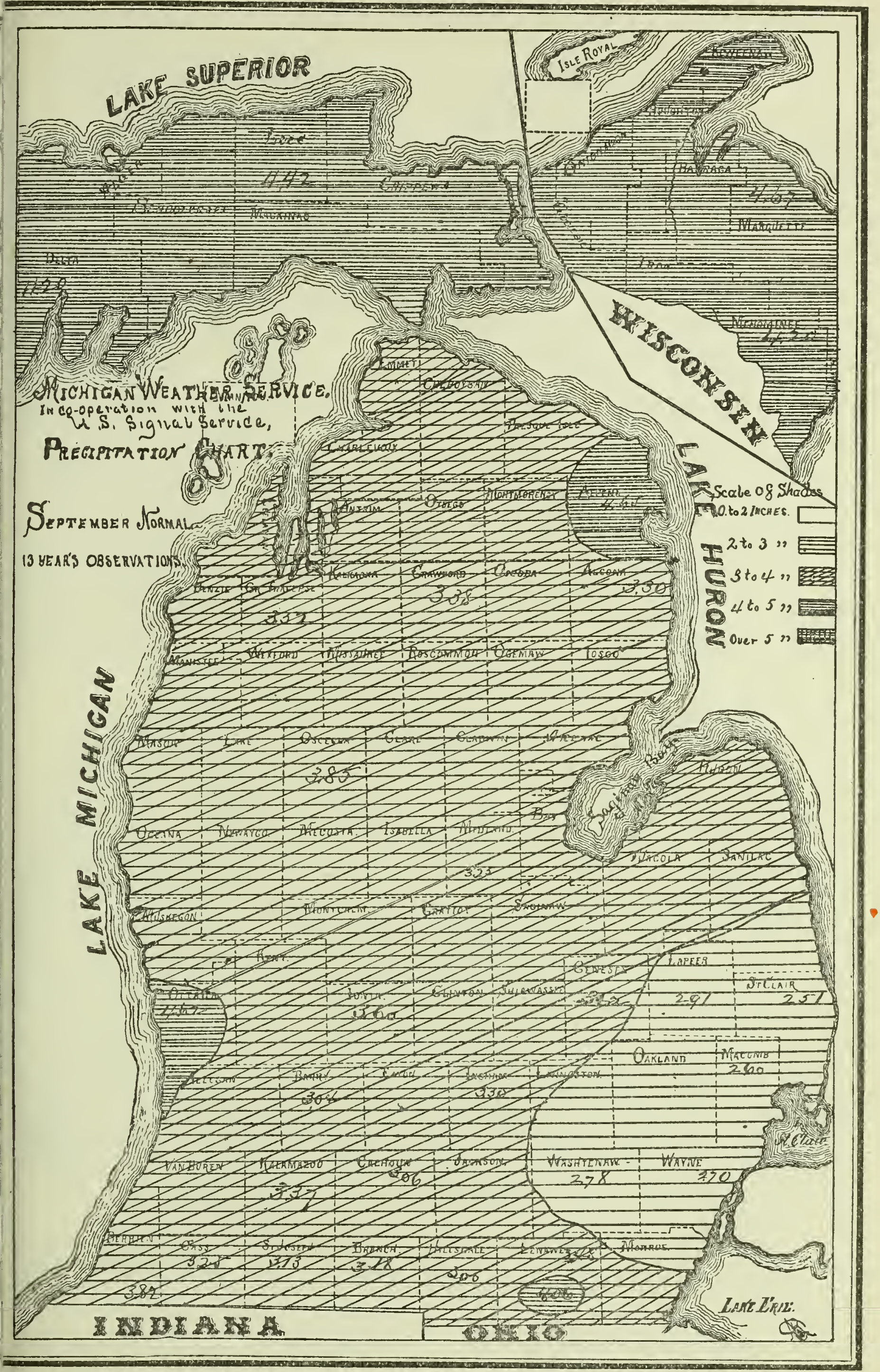

Michigan Weather Service.
in co-operation with the
U. S. Signal Service,
Precipitation Chart.
July 1888.
Scale of Shades
0 to 2 inches
2 & 3 "
3 & 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Lake Erie.
Saginaw Bay
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
0.87
Houghton
2.34
Ontonagon
Baraga
1.32
Marquette
Gogebic
Iron
Menominee
Luce
Alger
Schoolcraft
Mackinac
Chippewa
1.09
1.53
Delta
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
2.35
Leelanaw
Antrim
Otsego
1.16
Montmorency
1.20
Alpena
1.56
Benzie
2.60
Gr. Traverse
1.77
1.79
Kalkaska
1.26
Crawford
Oscoda
1.66
Alcona
1.37
Manistee
3.80
4.20
Wexford
Missaukee
Roscommon
Ogemaw
1.57
Iosco
Mason
2.35
Lake
Osceola
1.79
Clare
Gladwin
Arenac
0.79
3.18
Oceana
2.85
Newaygo
Mecosta.
1.27
Isabella
Midland.
Bay
Huron. 1.30
0.50
Tuscola
Sanilac
Muskegon
Montcalm.
Gratiot
0.94
0.92
Saginaw
2.02
Lapeer
1.29
Genesee
St. Clair
1.85
Kent.
Ottawa
1.59
Ionia.
1.41
Clinton
1.28
Shiawassee
1.92
1.90
2.31
2.71
4.24
Allegan
Barry
1.43.
Eaton
Ingham
2.00
2.00
Livingston
Oakland
2.13
Macomb
1.04
2.16
2.00
0.95
1.23
1.39
1.25
2.04
L. St. Clair
Van Buren
Kalamazoo
2.37
Calhoun
0.59
0.93
0.67
1.14
Jackson.
0.76
1.92
2.04
1.69
Washtenaw
2.04
0.78
Wayne
2.98
3.18
3.48
Berrien
Cass
1.23
1.86
1.57
St. Joseph
2.57
2.16
Branch.
0.91
1.39
0.89
Hillsdale
1.01
Lenawee
3.50
3.88
Monroe
2.47
2.65

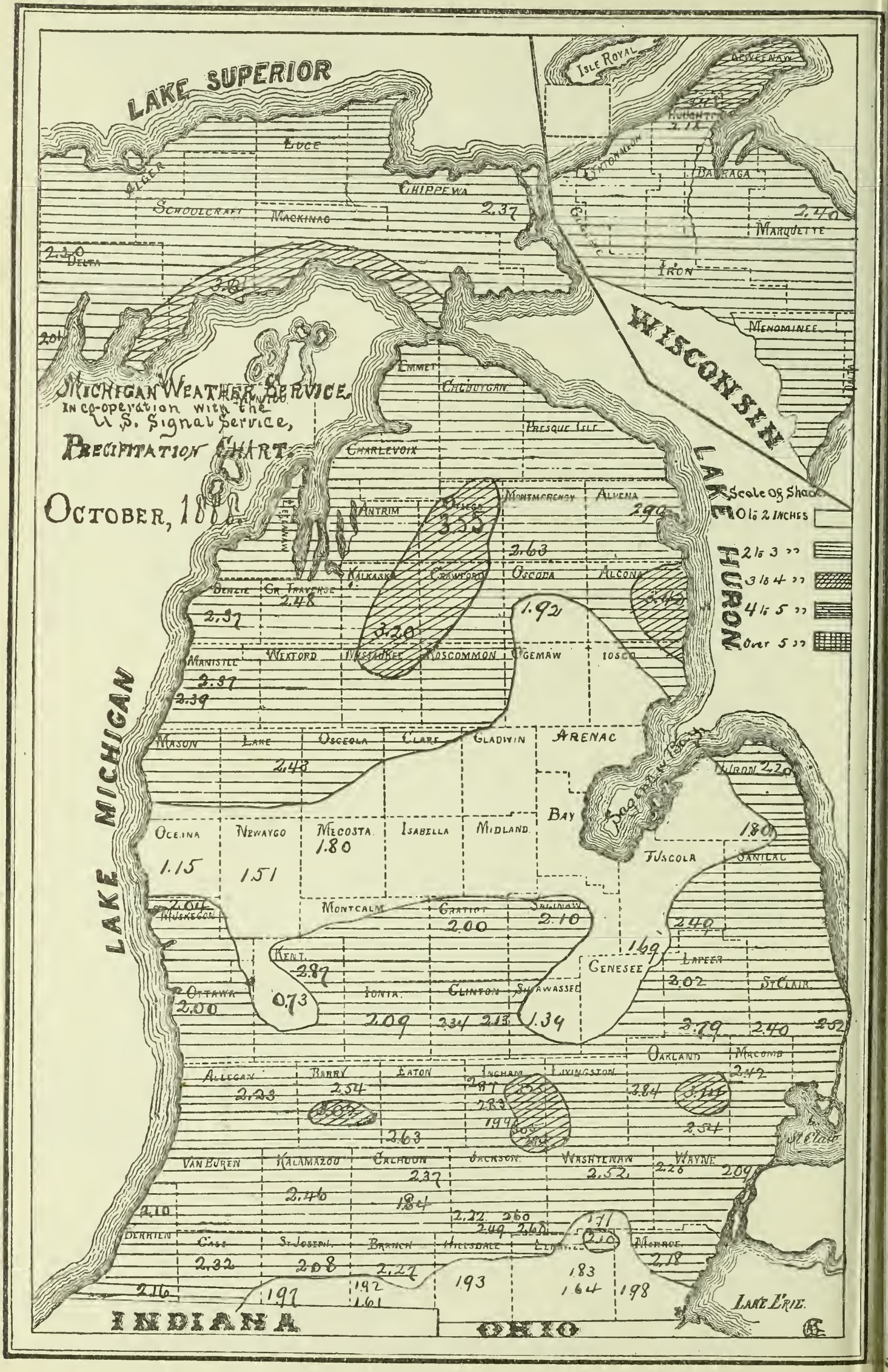

MICHIGAN WEATHER SERVICE.
In co-operation with the
U. S. Signal Service,
PRECIPITATION CHART.
July Normal.
13 YEARS OBSERVATIONS.
Scale of Shades.
0 to 2, inches
2 to 3 "
3 to 4 "
4 to 5 "
over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie.
Saginaw Bay
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
Marquette
3.13
Gogebic
Iron
Menominee
3.26
Luce
3.20
Chippewa
Schoolcraft
Mackinac
Delta
3.56
Alger
Manitou
Emmet
Cheboygan
2.79
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
Leelanaw
Benzie
Gr. Traverse
3.02
Kalkaska
Crawford
Oscoda
Alcona
2.96
2.88
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
2.52
Mason
Lake
3.02
Osceola
Clare
Gladwin
Arenac
2.79
Huron
2.96
Bay
2.96
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Genesee
2.92
Lapeer
3.30
St. Clair
2.85
Ottawa
3.26
Ionia
2.66
Clinton
Shiawassee
Oakland
Macomb
3.26
Allegan
Barry
3.08
Eaton
Ingham
3.72
Livingston
Van Buren
3.20
Kalamazoo
3.53
Calhoun
2.81
Jackson
Washtenaw
3.74
Wayne
3.94
St. Clair
Berrien
3.94
Cass
St. Joseph
3.99
Branch
3.42
Hillsdale
3.67
Lenawee
3.81
Monroe

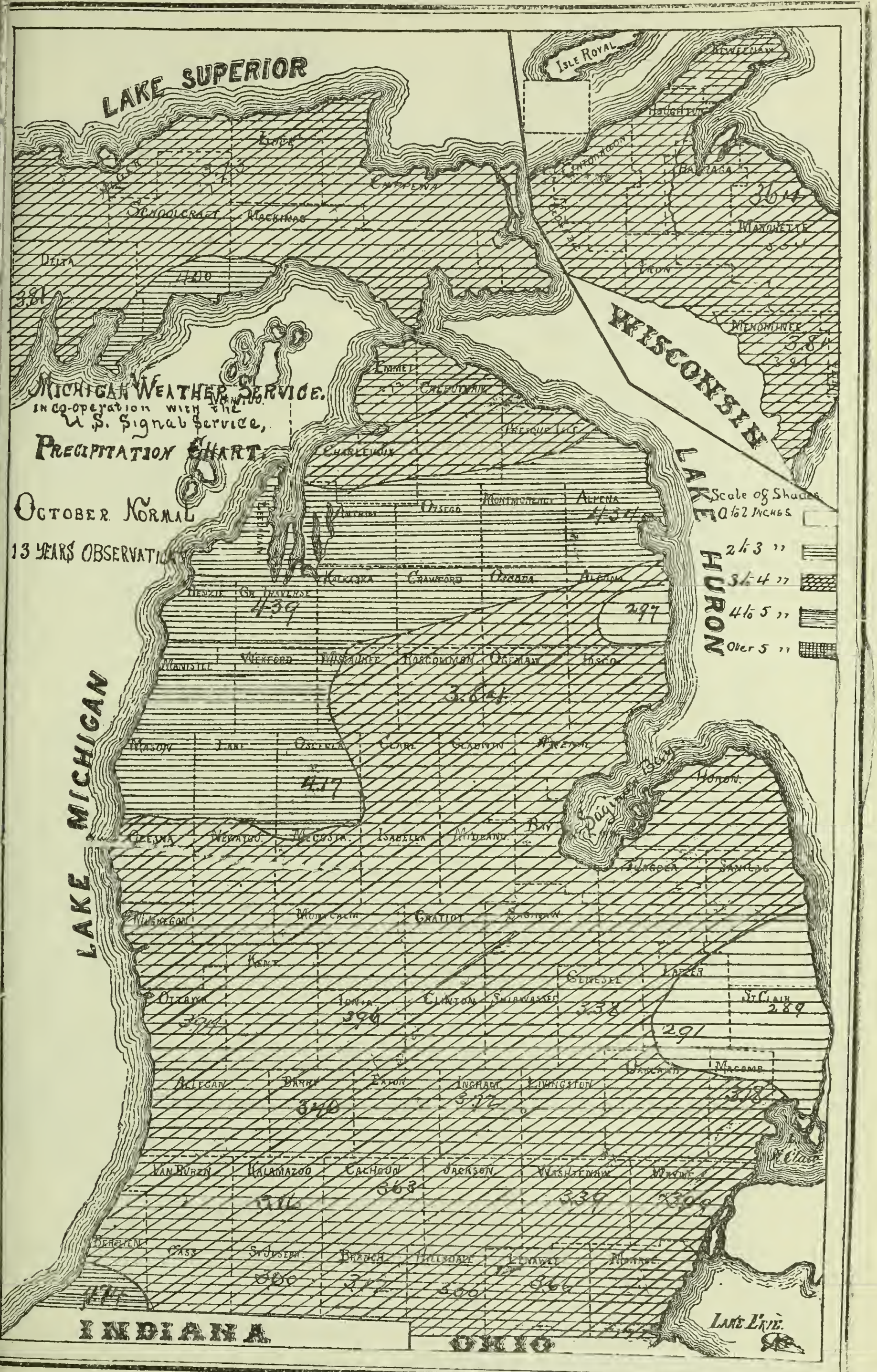

LAKE SUPERIOR
Isle Royal
Keweenaw
Alger
Schoolcraft
Mackinac
Luce
Chippewa
Ontonagon
Iron
Delta
1.96
187
Menominee
Wisconsin
Michigan Weather Service.
in co-operation with the
U. S. Signal Service,
Precipitation Chart.
August, 1888
Emmet
Cheboygan
Presque Isle
Charlevoix
1.95
Antrim
Montmorency
Alpena
3.45
3.30
Kalkaska
Crawford
Oscoda
Alcona
Grand Traverse
2.95
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
2.70
3.54
Mason
Lake
Osceola
Clare
Gladwin
Arenac
1.92
Bay
Saginaw Bay
Huron
Oceana
Newaygo
Mecosta
Isabella
Midland
4.30
4.46
Gratiot
1.51
Saginaw
Tuscola
Sanilac
2.39
2.67
Lapeer
Genesee
St Clair
1.78
Ottawa
2.59
1.43
Clinton
Shiawassee
1.12
1.81
0.99
Oakland
Allegan
Barry
1.00
Eaton
Ingham
1.68
1.55
1.84
2.54
Livingston
2.15
1.02
Van Buren
Kalamazoo
0.63
Calhoun
0.60
1.18
1.15
Jackson
Washtenaw
2.66
Wayne
1.12
Berrien
0.82
Cass
0.10
St Joseph
0.38
0.51
Branch
0.89
0.45
0.56
Hillsdale
1.48
Lenawee
1.20
1.19
1.55
Monroe
Lake Erie
LAKE MICHIGAN
LAKE HURON
Scale of Shades.
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
INDIANA
OHIO

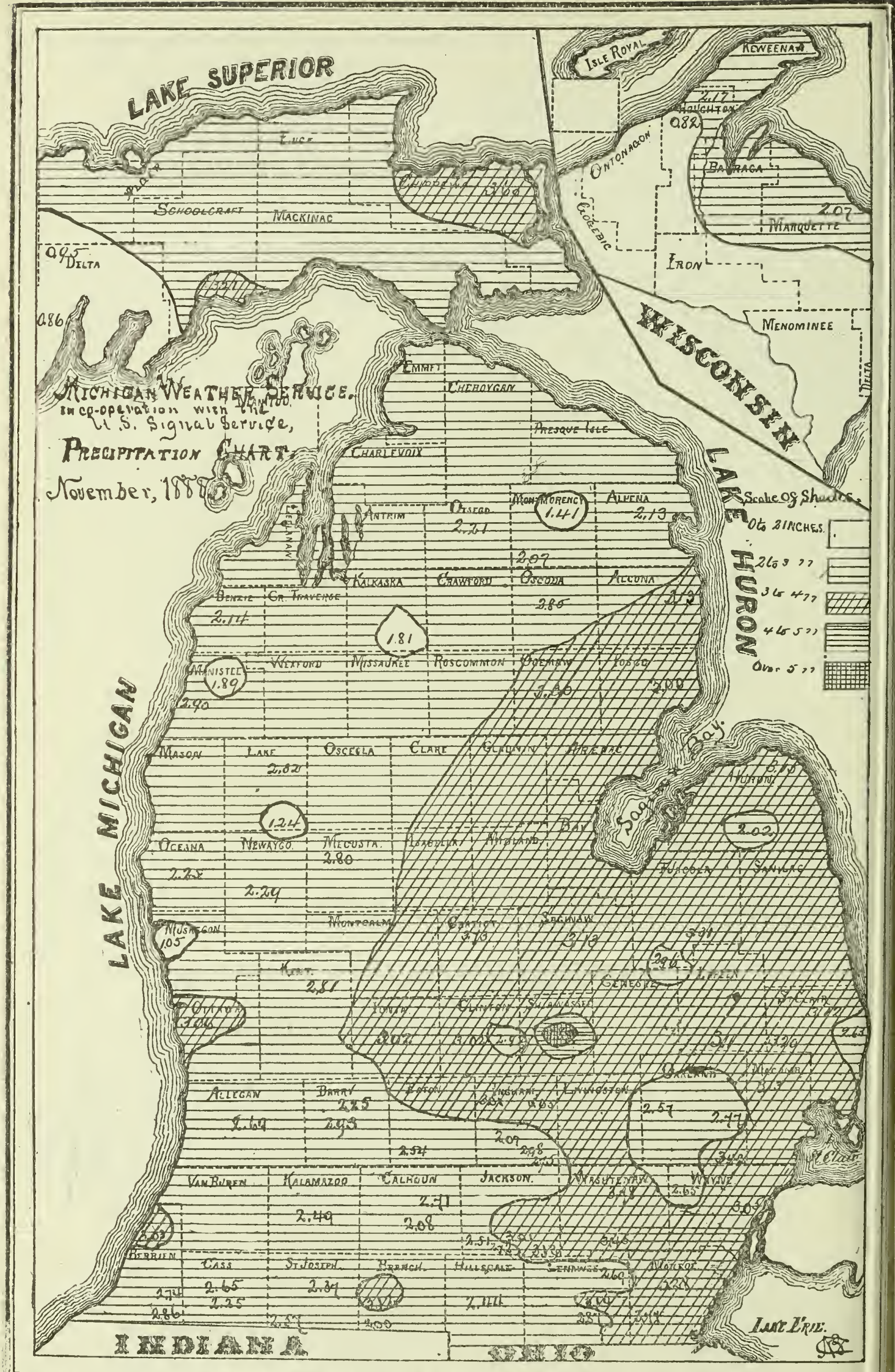

Michigan Weather Service.
in co-operation with the U. S. Signal Service,
Precipitation Chart.
August Normal
13 Years Observations
Scale of Shades.
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Lake Erie.
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
3.70
Marquette
Gogebic
Iron
Menominee
4.18
Alger
Luce
3.64
Chippewa
Schoolcraft
Mackinac
Delta
4.18
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
3.76
Benzie
Gd. Traverse
3.63
Kalkaska
Crawford
Oscoda
Alcona
3.37
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Mason
Lake
Osceola
Clare
Gladwin
Arenac
Saginaw Bay
Huron
3.06
Oceana
Newaygo
Mecosta
3.53
Isabella
Midland
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Genesee
Lapeer
Ottawa
Ionia
2.97
Clinton
Shiawassee
3.17
3.60
St. Clair
2.82
Oakland
Macomb
2.84
Allegan
Barry
Eaton
Ingham
3.72
Livingston
St. Clair
Van Buren
Kalamazoo
2.76
Calhoun
3.07
Jackson
Washtenaw
Wayne
2.91
Berrien
3.22
Cass
2.72
St. Joseph
Branch
2.94
Hillsdale
2.17
Lenawee
2.93
3.62
Monroe

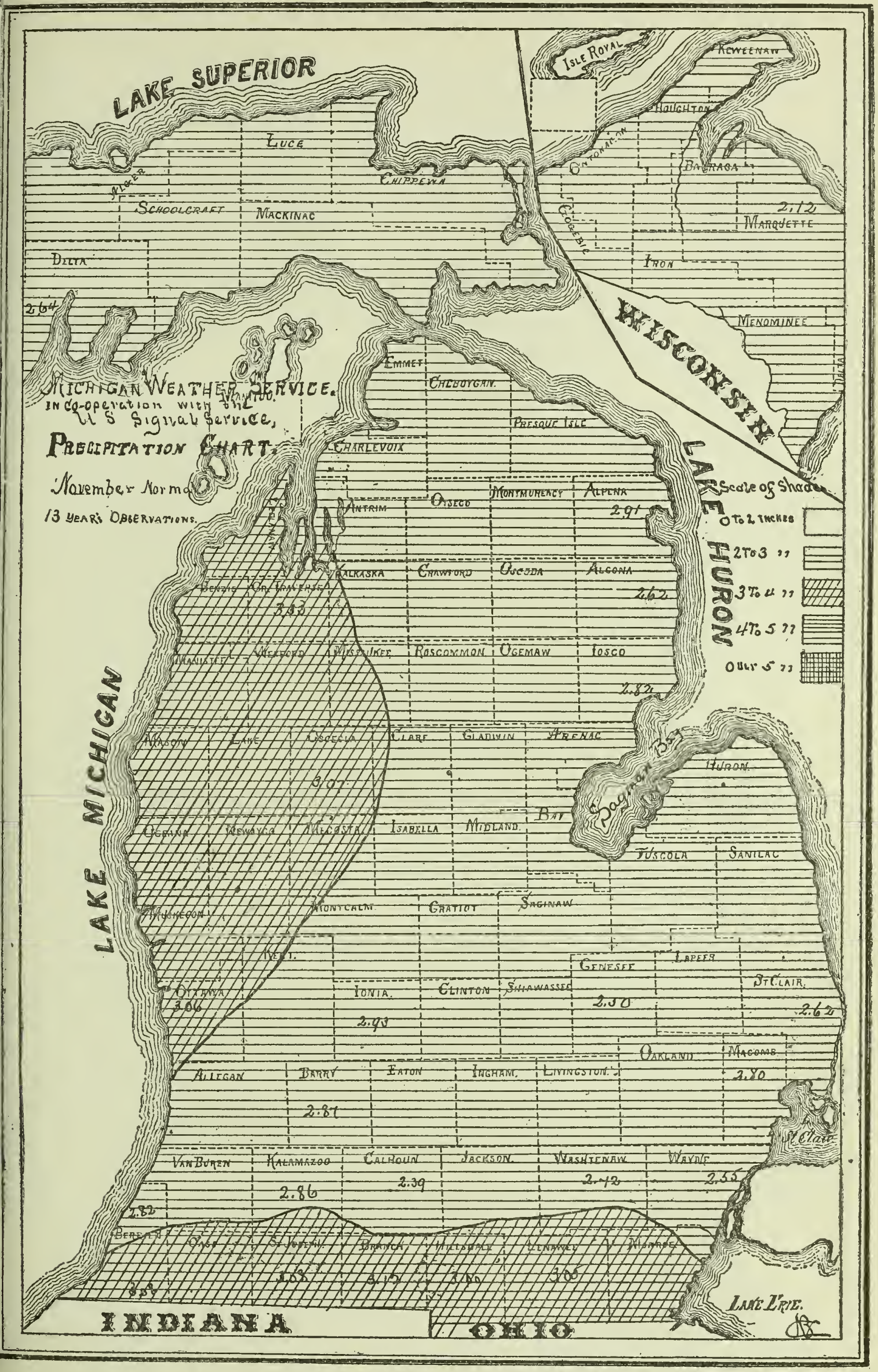

MICHIGAN WEATHER SERVICE.
In co-operation with the
U. S. Signal Service,
PRECIPITATION CHART.
SEPTEMBER 1888
Scale of Shades.
0. to 2 Inches ▭
2 to 3 " ▤
3 to 4 " ▨
4 to 5 " ▤
Over 5 " ▦
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
LAKE ERIE.
Isle Royal
Keweenaw
1.84
Houghton
2.29
Ontonagon
Baraga
Marquette
Gogebic
Iron
Menominee
Chippewa
3.97
Schoolcraft
Mackinac
Delta
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
3.10
Montmorency
1.91
1.89
Alpena
2.41
Alcona
3.00
Oscoda
2.03
Kalkaska
Crawford
2.80
Benzie
3.64
Gd. Traverse
5.16
Manistee
5.32
4.83
Wexford
Missaukee
Roscommon
Ogemaw
2.85
Iosco
Mason
Lake
Osceola
3.31
Clare
Gladwin
Arenac
1.14
Huron
0.76
1.45
2.91
Oceana
4.00
Newaygo
Mecosta
2.86
Isabella
Midland
Bay
Saginaw Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
2.32
Saginaw
2.38
1.04
1.08
Kent.
2.92
2.07
Ottawa
2.58
Ionia
1.80
1.88
Clinton
2.22
Shiawassee
1.55
Genesee
Lapeer
1.52
St. Clair
1.12
1.62
1.89
Allegan
Barry
2.40
2.48
Eaton
Ingham
1.91
3.07
1.88
2.92
2.01
2.03
Livingston
Oakland
0.66
1.16
1.19
Macomb
1.37
1.40
St. Clair
Van Buren
Kalamazoo
2.40
Calhoun
2.57
2.31
Jackson
2.13
1.92
2.19
1.13
Washtenaw
0.91
0.71
Wayne
1.26
Berrien
Cass
2.41
St. Joseph
1.82
Branch
2.92
Hillsdale
Lenawee
1.96
0.65
1.19
Monroe
0.73
1.69
1.61
2.30
1.59
B.

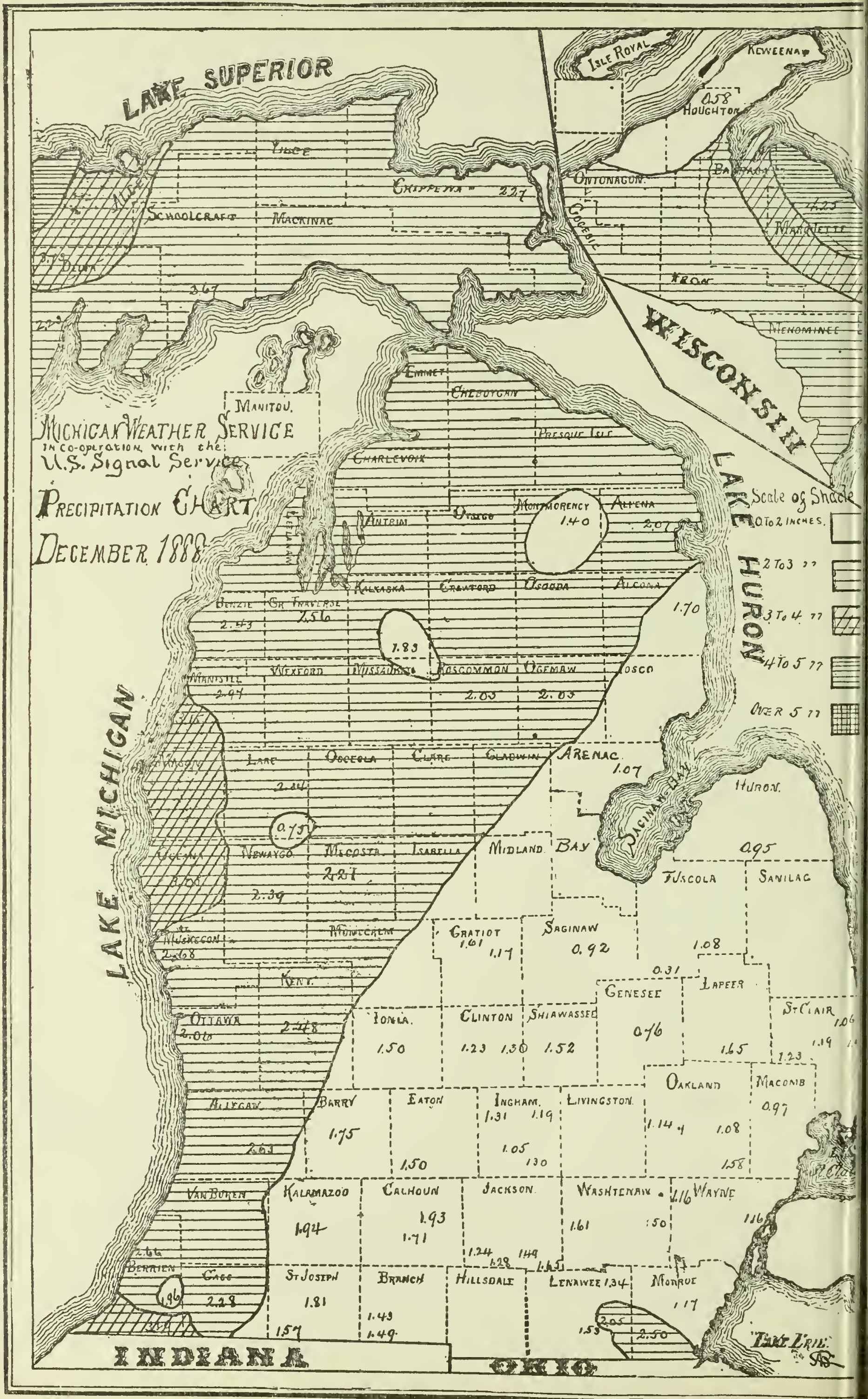

MICHIGAN WEATHER SERVICE.
In co-operation with the
U.S. Signal Service,
PRECIPITATION CHART.
SEPTEMBER NORMAL.
13 YEAR'S OBSERVATIONS.
Scale of Shades
0. to 2 INCHES.
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
ISLE ROYAL
KEWEENAW
HOUGHTON
BARAGA
MARQUETTE
4.67
MENOMINEE
4.20
WISCONSIN
CHIPPEWA
MACKINAC
4.42
DELTA
4.29
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
KALKASKA
CRAWFORD
OSCODA
ALCONA
3.30
3.38
BENZIE
GD. TRAVERSE
3.37
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
LAKE HURON
LAKE MICHIGAN
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
3.85
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT
LAPEER
GENESEE
OTTAWA
IONIA
3.60
CLINTON
SHIAWASSEE
2.91
ST CLAIR
2.57
OAKLAND
MACOMB
2.60
ALLEGAN
BARRY
3.04
EATON
INGHAM
3.30
LIVINGSTON
St. Clair
VAN BUREN
KALAMAZOO
3.37
CALHOUN
3.06
JACKSON
WASHTENAW
2.78
WAYNE
2.70
BERRIEN
3.82
CASS
3.23
ST JOSEPH
3.13
BRANCH
3.18
HILLSDALE
3.06
LENAWEE
MONROE
4.06
LAKE ERIE.
INDIANA
OHIO

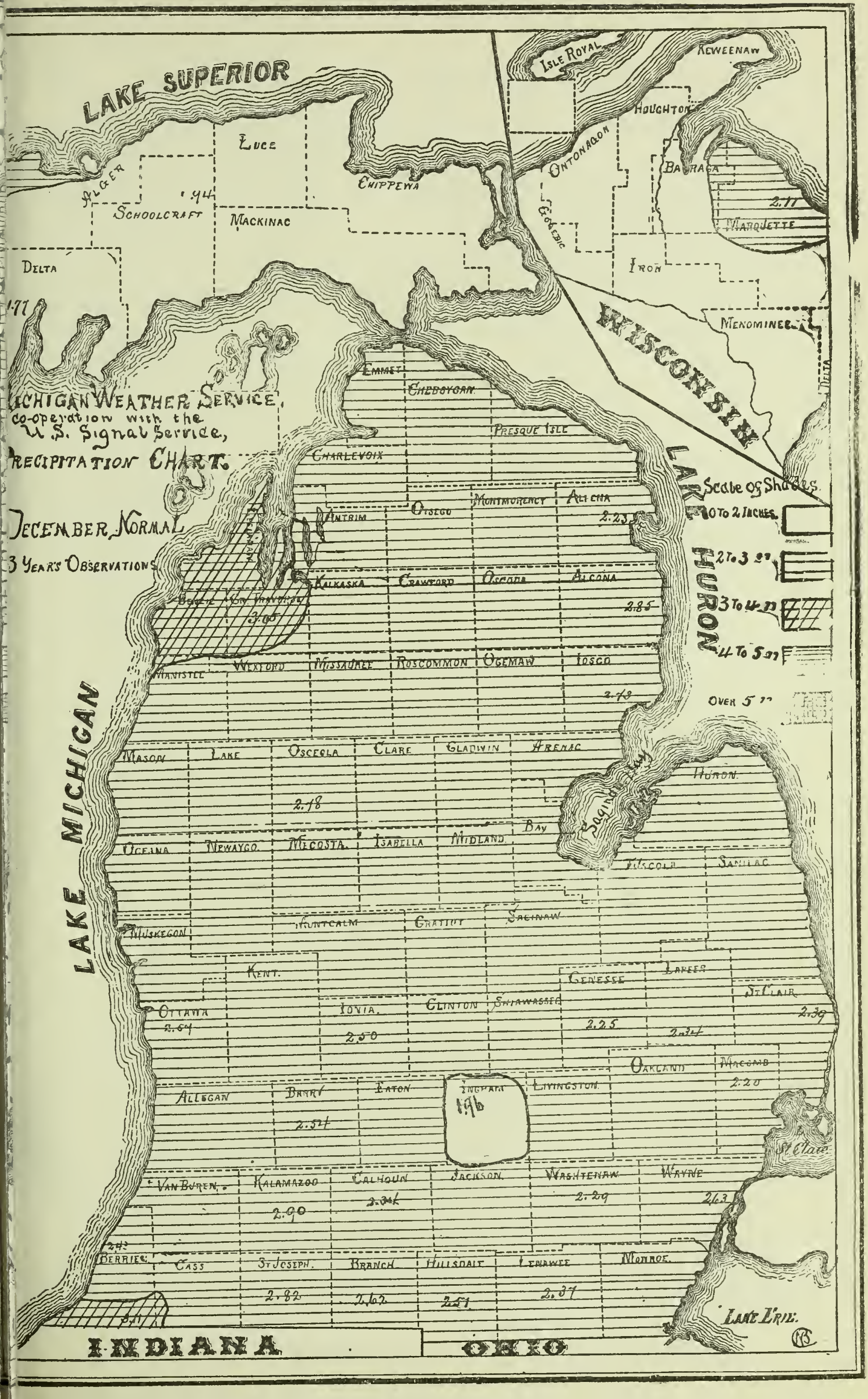

MICHIGAN WEATHER SERVICE.
In co-operation with the U. S. Signal Service,
PRECIPITATION CHART.
OCTOBER, 188
Scale of Shade
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE.
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
Marquette
Iron
Menominee
Delta
Alger
Luce
Chippewa
Schoolcraft
Mackinac
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
Leelanaw
Benzie
Gr. Traverse
Kalkaska
Crawford
Oscoda
Alcona
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Mason
Lake
Osceola
Clare
Gladwin
Arenac
Bay
Saginaw Bay
Huron
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Genesee
Lapeer
Kent
Ottawa
Ionia
Clinton
Shiawassee
St. Clair
Oakland
Macomb
Allegan
Barry
Eaton
Ingham
Livingston
Van Buren
Kalamazoo
Calhoun
Jackson
Washtenaw
Wayne
Berrien
Cass
St. Joseph
Branch
Hillsdale
Lenawee
Monroe
St. Clair
2.37
2.40
2.10
3.01
2.01
3.55
2.90
2.63
2.48
2.37
3.20
2.42
1.92
2.37
2.39
2.43
2.20
1.80
1.15
1.51
1.80
2.04
2.00
2.10
2.49
1.69
2.87
0.73
2.00
2.09
2.34
2.13
1.34
2.02
2.79
2.40
2.52
2.42
2.23
2.54
3.02
2.87
2.83
1.99
2.63
2.84
3.14
2.54
2.37
2.46
1.84
2.52
2.26
2.09
2.10
2.22
2.60
2.49
2.62
1.71
2.10
2.32
2.08
2.27
2.18
2.16
1.97
1.92
1.61
1.93
1.83
1.64
1.98

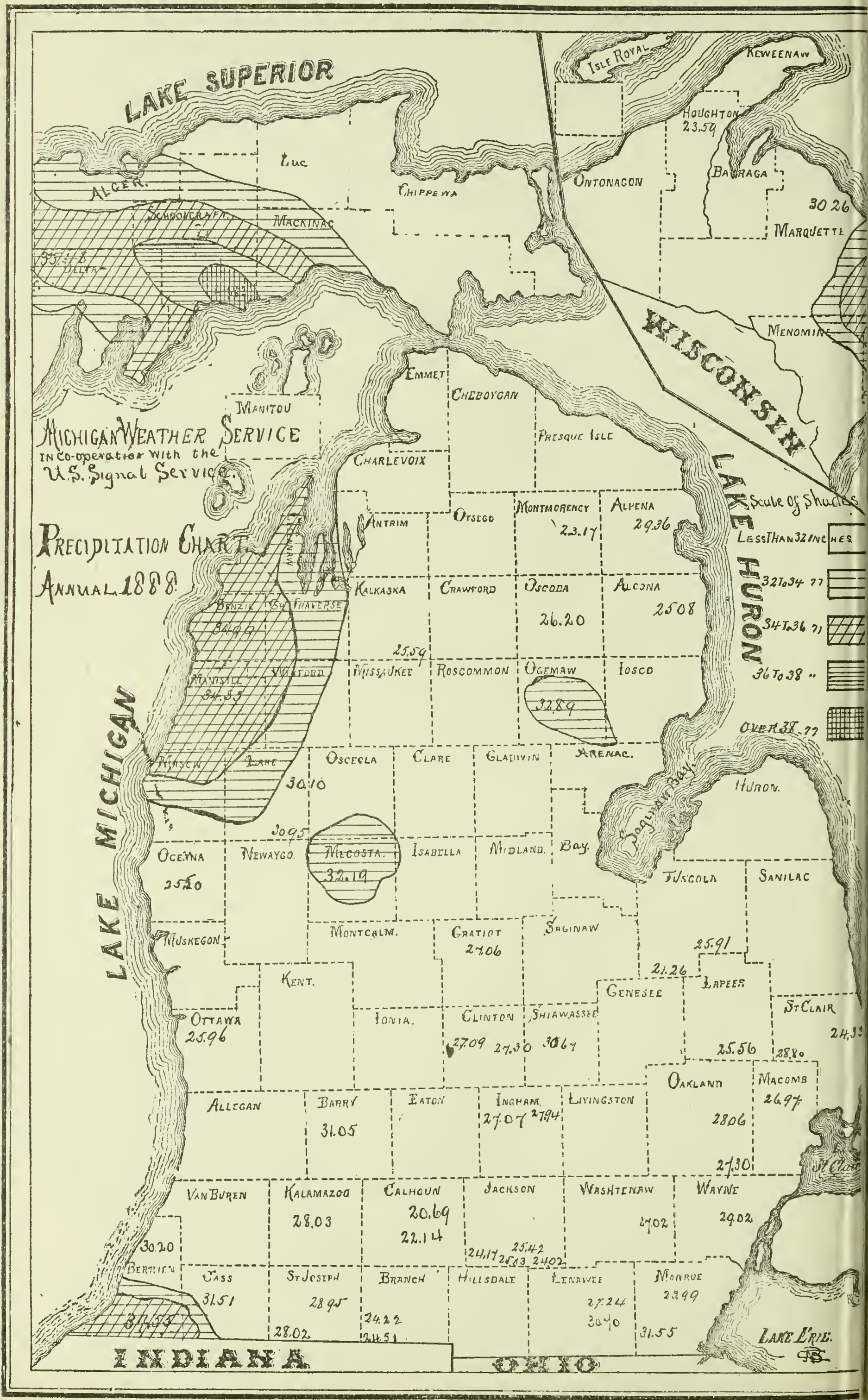

MICHIGAN WEATHER SERVICE.
IN CO-OPERATION WITH THE
U. S. SIGNAL SERVICE,
PRECIPITATION CHART.
OCTOBER NORMAL
13 YEARS OBSERVATION
Scale of Shades.
0 to 2 Inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie.
Saginaw Bay
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
Marquette
Iron
Menominee
Luce
Alger
Schoolcraft
Mackinac
Chippewa
Delta
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
Leelanaw
Benzie
Gd. Traverse
Kalkaska
Crawford
Oscoda
Alcona
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Mason
Lake
Osceola
Clare
Gladwin
Arenac
Huron
Oceana
Newaygo
Mecosta
Isabella
Midland
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Kent
Ottawa
Ionia
Clinton
Shiawassee
Genesee
Lapeer
St. Clair
Oakland
Macomb
Allegan
Barry
Eaton
Ingham
Livingston
Van Buren
Kalamazoo
Calhoun
Jackson
Washtenaw
Wayne
Berrien
Cass
St. Joseph
Branch
Hillsdale
Lenawee
Monroe
3.73
3.64
3.81
4.00
3.84
3.91
4.34
4.39
2.97
3.84
4.17
3.94
3.96
3.58
2.89
2.91
3.40
3.72
3.18
3.63
3.39
3.06
3.60
3.72
3.00
3.66

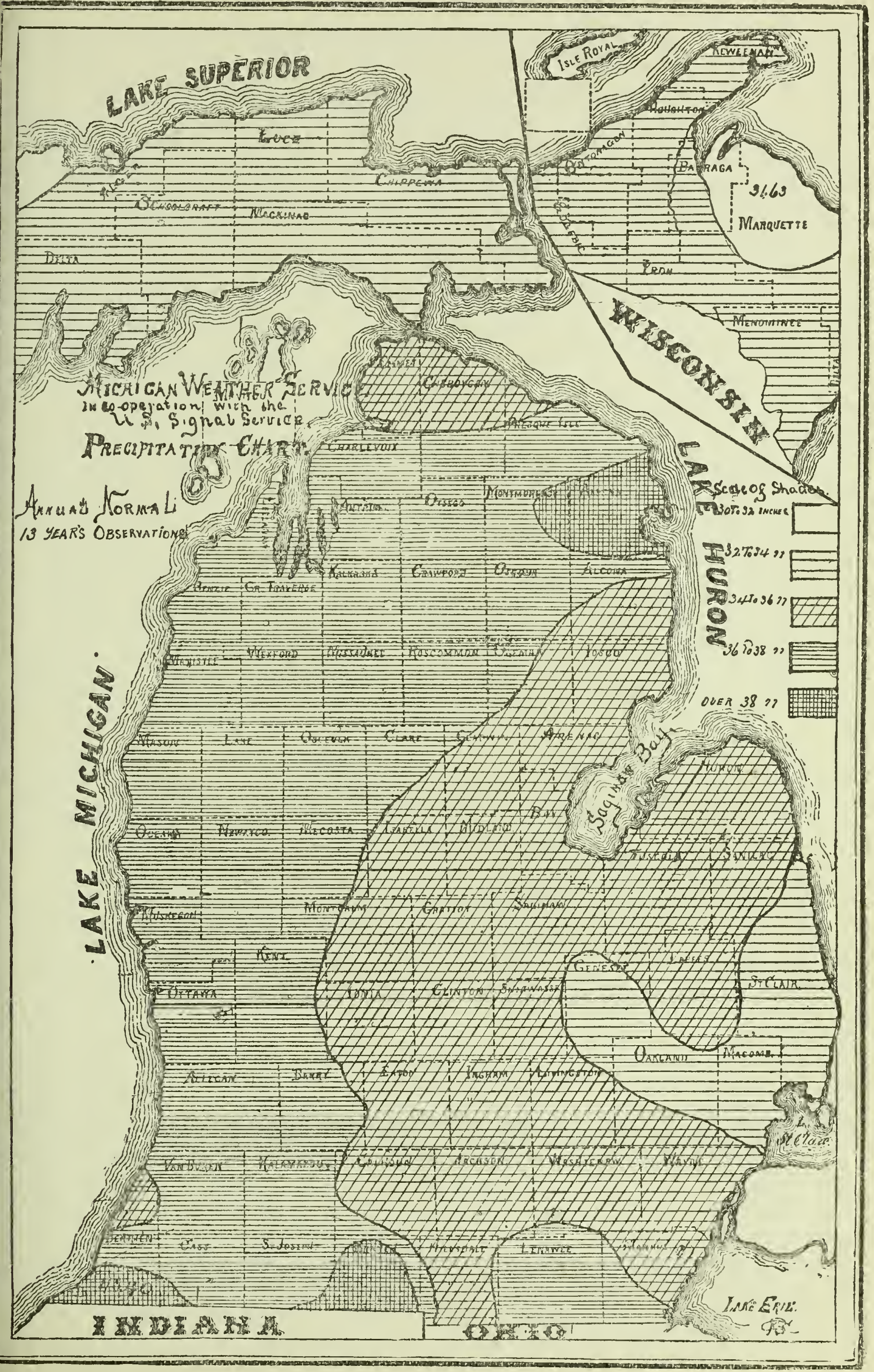

Michigan Weather Service,
in co-operation with the
U. S. Signal Service,
Precipitation Chart,
November, 1888.
Scale of Shades.
0 to 2 inches.
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie.
Saginaw Bay
Isle Royal
Keweenaw
Houghton
2.17
0.82
Ontonagon
Baraga
Marquette
2.07
Gogebic
Iron
Menominee
Luce
Schoolcraft
Mackinac
Chippewa
3.60
Delta
0.95
0.86
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Leelanaw
Montmorency
1.41
Alpena
2.13
Otsego
2.21
Kalkaska
Crawford
Oscoda
2.07
2.86
Alcona
Benzie
Gr. Traverse
2.14
1.81
Manistee
1.89
2.90
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Mason
Lake
2.82
Osceola
Clare
Gladwin
Arenac
Huron
1.24
Bay
Oceana
2.25
Newaygo
2.29
Mecosta
2.80
Isabella
Midland
Tuscola
Sanilac
2.02
Muskegon
1.05
Montcalm
Gratiot
Saginaw
Genesee
Lapeer
Kent
2.81
Ottawa
Ionia
Clinton
Shiawassee
St. Clair
Allegan
2.64
Barry
2.25
2.93
Eaton
Ingham
Livingston
Oakland
Macomb
2.57
2.77
2.54
2.07
Van Buren
Kalamazoo
2.49
Calhoun
2.71
2.08
Jackson
Washtenaw
Wayne
2.65
Berrien
Cass
2.65
2.25
St. Joseph
2.34
Branch
Hillsdale
Lenawee
Monroe
2.86


Michigan Weather Service.
in co-operation with the
U S Signal Service,
Precipitation Chart.
November Normal
13 Year's Observations.
Scale of Shade
0 to 2 inches
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie.
Isle Royal
Keweenaw
Houghton
Ontonagon
Baraga
Marquette
2.12
Gogebic
Iron
Menominee
Delta
Alger
Luce
Chippewa
Schoolcraft
Mackinac
Delta
2.64
Manitou.
Emmet
Cheboygan.
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
2.91
Leelanaw
Benzie
Gr. Traverse
3.33
Kalkaska
Crawford
Oscoda
Alcona
2.62
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
2.82
Mason
Lake
Osceola
3.07
Clare
Gladwin
Arenac
Huron
Saginaw Bay
Oceana
Newaygo
Mecosta
Isabella
Midland.
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Ottawa
3.06
Kent.
Ionia.
2.93
Clinton
Shiawassee
Genesee
2.50
Lapeer
St. Clair.
2.62
Oakland.
Macomb.
2.80
Allegan
Barry
2.81
Eaton
Ingham.
Livingston.
St. Clair
Van Buren
2.82
Kalamazoo
2.86
Calhoun
2.39
Jackson.
Washtenaw
2.42
Wayne
2.55
Berrien
Cass
St. Joseph
Branch
Hillsdale
Lenawee
Monroe
3.54
3.08
3.15
3.10
3.05


Michigan Weather Service
in co-operation with the
U.S. Signal Service
Precipitation Chart
December 1888
Scale of Shade
0 To 2 inches.
2 To 3 "
3 To 4 "
4 To 5 "
Over 5 "
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Saginaw Bay
Wisconsin
Indiana
Ohio
Isle Royal
Keweenaw
Houghton 0.58
Ontonagon
Baraga
Marquette 4.25
Gogebic
Iron
Menominee
Alger
Luce
Chippewa 2.27
Schoolcraft
Mackinac
Delta 3.19
3.67
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency 1.40
Alpena 2.07
Kalkaska
Crawford
Oscoda
Alcona
1.70
Benzie 2.43
Gr. Traverse 2.56
1.83
Manistee 2.94
Wexford
Missaukee
Roscommon 2.05
Ogemaw 2.05
Iosco
Mason 3.15
Lake 2.24
Osceola
Clare
Gladwin
Arenac 1.07
Huron
0.75
Oceana 3.06
Newaygo 2.39
Mecosta 2.27
Isabella
Midland
Bay
0.95
Tuscola
Sanilac
Muskegon 2.68
Montcalm
Gratiot 1.61 1.17
Saginaw 0.92
1.08
0.31
Genesee 0.76
Lapeer 1.65
St. Clair 1.06 1.19 1.23
Kent
Ottawa 2.06
2.48
Ionia 1.50
Clinton 1.23 1.30
Shiawassee 1.52
Oakland 1.14 1.08 1.58
Macomb 0.97
Allegan 2.61
Barry 1.75
Eaton 1.50
Ingham 1.31 1.19 1.05 1.30
Livingston
Van Buren
Kalamazoo 1.94
Calhoun 1.93 1.71
Jackson 1.24 1.28 1.49
Washtenaw 1.61 1.50 1.45
Wayne 1.16 1.16
2.66
Berrien 1.96
Cass 2.28
St. Joseph 1.81 1.57
Branch 1.43 1.49
Hillsdale
Lenawee 1.34 1.55 2.05
Monroe 1.17 2.50


ICHIGAN WEATHER SERVICE,
co-operation with the
U.S. Signal Service,
RECIPITATION CHART.
DECEMBER NORMAL
3 YEAR'S OBSERVATIONS
Scale of Shades.
0 to 2 Inches.
2 to 3 "
3 to 4 "
4 to 5 "
Over 5 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE.
WISCONSIN
INDIANA
OHIO
ISLE ROYAL
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
2.11
MARQUETTE
GOGEBIC
IRON
MENOMINEE
DELTA
1.77
ALGER
LUCE
SCHOOLCRAFT
.94
MACKINAC
CHIPPEWA
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
2.23
KALKASKA
CRAWFORD
OSCODA
ALCONA
2.85
BENZIE
GR. TRAVERSE
3.05
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
2.48
MASON
LAKE
OSCEOLA
2.48
CLARE
GLADWIN
ARENAC
Saginaw Bay
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT
GENESSE
2.25
LAPEER
2.24
ST. CLAIR
2.39
OTTAWA
2.64
IONIA
2.50
CLINTON
SHIAWASSEE
OAKLAND
MACOMB
2.20
ALLEGAN
BARRY
2.54
EATON
INGHAM
1.96
LIVINGSTON
St. Clair
VAN BUREN
KALAMAZOO
2.90
CALHOUN
2.34
JACKSON
WASHTENAW
2.29
WAYNE
2.63
2.42
BERRIEN
CASS
ST. JOSEPH
2.82
BRANCH
2.62
HILLSDALE
2.51
LENAWEE
2.37
MONROE
3.41


Michigan Weather Service
in co-operation with the
U.S. Signal Service.
Precipitation Chart.
Annual 1888.
Scale of Shades
Less than 32 inches
32 to 34 "
34 to 36 "
36 to 38 "
Over 38 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
Saginaw Bay
Lake Erie.
WISCONSIN
INDIANA
OHIO
Isle Royal
Keweenaw
Houghton
23.59
Baraga
30.26
Marquette
Ontonagon
Menominee
Luc
Chippewa
Alger.
Schoolcraft
Mackinac
Delta
35.48
Manitou
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
23.17
Alpena
29.36
Kalkaska
Crawford
Oscoda
26.20
Alcona
25.08
Benzie
Gd Traverse
34.90
25.59
Missaukee
Roscommon
Ogemaw
32.89
Iosco
Manistee
Wexford
34.53
Mason
Lake
30.10
Osceola
Clare
Gladwin
Arenac.
Huron.
30.95
Oceana
25.20
Newaygo.
Mecosta.
32.19
Isabella
Midland.
Bay.
Tuscola
Sanilac
Muskegon
Montcalm.
Gratiot
27.06
Saginaw
25.91
21.26
Lapeer
Genesee
St Clair
24.33
Kent.
Ottawa
25.96
Ionia.
Clinton
27.09
27.30
Shiawassee
30.67
25.56
28.80
Oakland
28.06
Macomb
26.97
Allegan
Barry
31.05
Eaton
Ingham
27.07
27.94
Livingston
27.30
St Clair
Van Buren
Kalamazoo
28.03
Calhoun
20.69
22.14
Jackson
24.17
25.42
25.63
24.02
Washtenaw
27.02
Wayne
29.02
30.20
Berrien
Cass
31.51
St Joseph
28.95
28.02
Branch
24.22
24.51
Hillsdale
Lenawee
27.24
30.70
Monroe
23.99
31.55
31.43


MICHIGAN WEATHER SERVICE
In co-operation with the
U. S. Signal Service
PRECIPITATION CHART.
Annual Normal
13 YEAR'S OBSERVATIONS
Scale of Shades.
30 To 32 INCHES
32 To 34 "
34 To 36 "
36 To 38 "
OVER 38 "
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
Lake Erie
L. St Clair
Saginaw Bay
ISLE ROYAL
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
MARQUETTE
34.63
IRON
MENOMINEE
DELTA
SCHOOLCRAFT
MACKINAC
CHIPPEWA
Luce
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
KALKASKA
CRAWFORD
OSCODA
ALCONA
BENZIE
GR. TRAVERSE
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
HURON
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
BAY
TUSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT
GENESEE
LAPEER
ST CLAIR
OTTAWA
IONIA
CLINTON
SHIAWASSEE
OAKLAND
MACOMB
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
S. JOSEPH
HILLSDALE
LENAWEE
MONROE

NO. 44.—FARM DEPARTMENT.

FEEDING STEERS OF DIFFERENT BREEDS.

By request of the Michigan Galloway and Holstein Cattle Breeders' Associations, the bulletins heretofore published on the feeding of steers of different breeds are, in substance, published with this final report, as an appendix, so that the complete report of the experiment is contained in this bulletin.

The last report carried the steers to October 10, 1887. The November following they were shown at the Chicago Fat Stock Show, attracting some attention from those who were familiar with the object of the experiment, and who knew that the aim had been to keep them in a thriving, growing condition, as they were to be carried another year. To have had them in the pink of perfection at this time would have increased many fold the chances of failure in the last year's feeding. Some visitors, who could only see merit in animals carrying great masses of flesh, passed our exhibit with a kind of semi-patronizing air, if not a direct criticism on the leanness of the cattle. They did not stop for weights, which showed plainly that their growth was above the average. "Many men of many minds," and I was amused by the grim courtesy of a Kansas City gentleman who took the pains to return a bulletin that had been given him, with the endorsement: "While the object sought to be obtained is well worthy a trial, yet from exhibit at Chicago, allow me to suggest that if the feeding was done by scientific feeders it would be better for the animals to be turned over to the unscientific feeders."

But there were many thoughtful men who stopped long enough to learn what the exhibit meant, and were not slow to pronounce the work important and in the right direction. So that on the whole I was pleased with the results of the show.

The steers were a good deal worried in going to Chicago. Were delayed somewhat and crowded on the car, and it took them several days to recover what they had lost by the trip. Mr. Robert Tulis had them in charge, and was assisted at the show by sophomores W. J. Robinson of Detroit and O. A. Turner of Grand Rapids.

The steers, while feeding in the main well, did not make as great gains during the winter as I had looked for. They were thriving and vigorous, however, and, with a few exceptions, made some advance in weight each month. They were allowed the run of a small yard daily for some three hours, for exercise, and fed and cared for in the same manner as noticed heretofore.

On June 1, Robert Tullis, the trusty Scotchman who had looked after the steers since the feeding began, decided to go to his family in Australia, and June 15, Thomas Jack took his place, and had charge of the lot until they were slaughtered in Chicago. He has proved himself an efficient and reliable helper, and to his prompt and painstaking effort in carrying out my instructions, much of the credit of the final finish is due. He is in charge of the new lot just put in the barns for the second test. The last of May, when the pasture was "a full bite," we accustomed the steers to grass gradually, and, for a couple of months, they got a good portion of their feed in the fields, adjoining the barn. They consumed only a small amount of grain during this period, as reference to the tables will show, and but little hay. I have no doubt that a cessation of the grain ration, for a time, was beneficial, and that they fed to better advantage after this rest from dry food. They were placed in their stalls daily, however, and offered grain, but they consumed very little. As the drought affected the pastures, we soon had to return to full feeding in stalls, and up to the 7th of September, when the lot was shipped to Jackson, to the State fair, they had made fair gains.

The steers were shown at the State fair at Jackson; the next week at the West Michigan at Grand Rapids; and then at the Central Michigan at Lansing. They were away from the College on this trip four weeks continuously, and yet, so well were they cared for and handled, that, with one exception, they had more than held their own. They proved an attractive exhibit at the fairs. On account of the Central fair occurring at same date as the Ionia county fair, we were compelled to give up our plan to exhibit there, as we felt under prior obligations to our home fair. I wish especially to thank the officials of all these shows for courtesies extended.

In no month during the experiment did the steers feed to better advantage than the one after their fair trip up to the time of their shipment to Chicago, November 8, for the final exhibit at the Fat Stock Show, in charge of Thomas Jack, assisted by Sophomore J. R. Frank, of Rochester, Mich. The steers were in very good trim, not fat enough to show, perhaps, to good advantage with the cattle fitted expressly for the show, while on foot; but giving them a good rub when placed on the block. The exhibit attracted much attention and favorable comment from the leading breeders of the country. I subjoin a few extracts from various sources: The editor of one of our leading farm journals says: "The more I reflect on your ten steers at Chicago the more I appreciate the importance to our feeders of your very interesting experiment as tending to do something that the Fat Stock Show seems never likely to accomplish, namely, to indicate the comparative merits of the various breeds for the profitable production of beef."

Another says: "The exhibit was the educational feature of the show. Here was the object lesson of animals of six breeds, fed under same conditions from calfhood, giving to visitors at a glance the differences in form, size, weight, finish and other characteristics."

The Country Gentleman calls it, "A specially noteworthy show."

The Orange Judd Farmer says: "As a matter of study, and an encouragement to experiments in practical agriculture, it will well pay those attending the Stock Show to take a look at these animals."

The Illnois Board of Agriculture very courteously gave me a hearing, and after discussing the subject came to the conclusion that as we had only one animal of each of two breeds we should confine the slaughter to one of each breed. This decision was, I believe, a wise one. The Board also decided that I must select the animals to exhibit and for the slaughter test. I endeavored in each case to select the animal that I thought, everything considered, would make the best showing for the breed. It was thought by some Shorthorn breeders that the steer Holt would have made the better carcass. He might have done so, but the carcass of Homer compared very favorably with that of the sweepstakes steer of that class, and I do not think there is much ground for criticism. Homer was over-ripe. I think Holt was also. They would have given better carcasses six months younger.

I wish to express my cordial appreciation of the courtesies extended by President Dysart, Secretary Mills, Supts. Funk and Moore of the cattle exhibit, and Mr. Hostetter, in charge of the books of that department. To these gentlemen we had occasion to refer frequently, and to their kind attention we are greatly indebted.

At my suggestion the Board of Agriculture decided upon the appointment of a committee to pass upon the merits of the steers as beef producers, market demand and price being taken into the account. We were especially fortunate in having a committee whose intelligence, experience, and fairness greatly emphasized the value of their decision. Mr. Stocking is an old time feeder from Central Illinois, and, like Mr. Imboden, has almost a national reputation, gained by their very efficient services as judges at former fat stock shows, while Mr. Ingwersen brought the experience of many years in buying in the greatest cattle market of the world.

The steers were shown November 19, and the following report made of their comparative merits by the committee.

To the Illinois State Board of Agriculture:

Your committee appointed to examine the steers of different breeds, fed by the Farm Department of the Michigan Agricultural College, to determine their value as far as profit to the feeder, their market value, and a profitable carcass from the butcher's and consumer's standpoint, submit the following report:

The Shorthorn steer, Homer, we rank first in the lot so far as profit from the feeder's standpoint is concerned. He weighing 1,870 lbs. at 1,071 days old, a gain of 1.74 lbs. per day. Homer also ranks first in value for the market as well as the block. On most markets he would outsell any of the others.

The Hereford steer, Hendricks, as a butchers' bullock is equal to the Shorthorn. He has not made growth enough for age, weighing 1,450 lbs. at 1,100 days, a daily gain of 1.32 lbs., to make a profitable beast for the breeder. On account of the lack of weight he would not bring quite so much as the Shorthorn in the market.

The Devon steer, Latitude, we should place third as a butchers' bullock and a seller in the market. While he is a well fleshed and even steer, he has not made growth enough to be profitable to the feeder, weighing 1,270 lbs. at 953 days, a gain per day of 1.33 lbs.

The Galloway steer, King Jumbo, on account of his rapid growth, weighing 1,620 lbs. at 987 days, a daily gain of 1.64 lbs., should be ranked second as a profitable beast for the breeder. While he lacks somewhat the finish and quality of the Devon, on account of his greater weight he would rank with him in market value. As a butchers' bullock we should rank him fourth, his finish not being quite equal to the Devon.

The Holstein steer, Nicholas, has also made rapid growth, weighing 1,660 lbs. at 976 days old, a growth of 1.70 lbs. per day, which would class him with the Galloway, from the standpoint of giving good returns to the feeder. He, however, lacks the quality which makes the best type of a butchers' bullock. He is too coarse, in the opinion of your committee, to make a profitable bullock, for the reason that, when finished and placed on the present markets, he would have to sell at a reduced price, from $1.00 to $1.50 per hundred less than the Shorthorn or Hereford.

The Jersey steer, Roscoe, while an excellent specimen of the breed, should rank lowest as a feeder, weighing only 1,420 lbs. at 1,161 days old, a daily gain of 1.28 lbs. In the present markets we think he would sell for the same price as the Holstein, while, as a butchers' beast, on account of his finer bone and ripeness, he would be superior.

WM. STOCKING,
Feeder, Rochelle, Ill.
C. G. INGWERSEN,
Live Stock Commission Merchant, Union Stock Yards, Chicago, Ill.
J. G. IMBODEN,
Representing Imboden Bros., Butchers, Decatur, Ill.

On Tuesday, November 20, the following steers, being the same ones passed upon by the committee whose report precedes this, were slaughtered. The following table will give such facts as may be of interest in the comparison. After hanging 36 hours the carcasses were weighed and placed upon the tables for the final inspection. The following report was made on the dressed carcasses by the same committee that awarded the premiums in the dressed meat classes of the show:

To the Illinois State Board of Agriculture:

Your committee selected to report on the respective merits of the carcasses of six steers, each of a different breed, exhibited by the Michigan Agricultural College, respectfully report:

That as to quality and percentage of edible meat combined, making a profitable carcass for the butcher and consumer as well, we place first, the Hereford; second, the Devon; third, the Galloway; fourth, the Jersey; fifth, the Shorthorn; sixth, the Holstein.

RUDOLPH WEBER, *Chicago, Ill.*
MICHAEL OAKES, *Chicago, Ill.*
B. B. BONNER, *Chicago, Ill.*

NOTES ON CARCASSES.

There was but little difference between the carcasses of the Hereford and Devon. The meat in both was well marbled. The fat of a light color, laid on evenly but not to excess.

The Galloway had less fat. The meat was not quite so well marbled but was pronounced by all judges a carcass that would cut up very profitably.

The Jersey was especially characterized by the yellow color of the fat. The meat was excellently marbled with a sufficient amount of fat, so that it would cut up to good advantage.

The Shorthorn carcass had too much fat on the outside, and this not quite evenly distributed, but the cuts in the best parts were thick and finely marbled. On account of the excess of fat it was not thought as profitable a carcass for the butcher or consumer.

The Holstein carcass was less marbled than the others, and the meat was somewhat darker colored. The outside of the carcass was of a rather bluish cast, well covered with fat but not in excess. It must have given a good per cent of edible meat.

In speaking of the carcasses, The Breeders' Gazette says: "To the great surprise of some people the Jersey showed probably the finest grained carcass of the lot, the Devon, Hereford, and Shorthorn all presenting surprisingly rich cuts in the best parts, rivaling in fact the prize beef on the society's tables. It was a creditable showing in every way."

The Orange Judd Farmer says: "The most interesting part was when the judges passed upon the merits of the different breeds tested in the Michigan College experiments. A few comments caught by the way during the judging of these carcasses will aid very materially in forming an opinion upon the relative merits of this particular number. 'The Jersey will eat like a spring chicken,' 'no waste to it,' 'there's no piece of meat in the house that will out eat it,' 'the carcass drops away a little back of the shoulders and is a little coarse in the neck. (After tasting it). Just as I said it was.' 'The Shorthorn is very dear beef—over ripe.' They were surprised at the amount of fat. The Devon was considered the nicest meat for smaller butchers."

Very good photographs of the animals alive, and also of cuts of the fore and hind quarters of each of the dressed carcasses, were taken by Mr. John W. Hills, of Delaware, Ohio. These last give quite an accurate representation of the proportion of fat and lean, and the marbling of the same in the carcasses of the different breeds, and have been reproduced by the photo-lithograph process for insertion here as a definite illustration of the edible qualities of the meat of the different breeds.

The numbers on the cuts are used to refer to the different breeds as follows:

No. 1 represents the Devon, No. 2, the Hereford; No. 3, the Jersey; No. 4, the Galloway; No. 5, the Shorthorn, and No. 6, the Holstein.

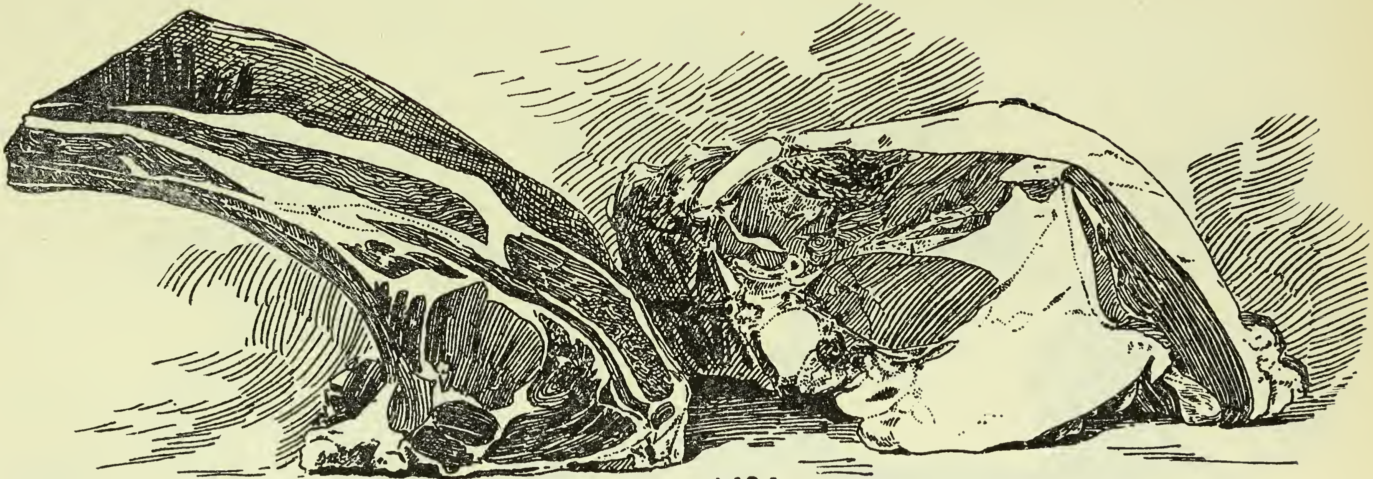
Portions of each of the carcasses were sold to Hon. J. Irving Pearce, of the Sherman House, Chicago. I was very glad to place samples of the beef of each breed where its edible qualities would be as thoroughly tested as in this famous hostelry. Mr. Pearce's report will be read with interest in this connection.

Mr. Pearce says: "Taken as a whole the beef was very good. My head cook, who is an unusually intelligent and experienced handler of meats, says (and I have bought beef at every one of the Fat Stock Shows held here) that it was the best flavored and most profitable, from having the least waste meat, of any that I have ever bought at these shows.

"I found the Jerseys gave me a larger proportion of edible meat than any of the other carcasses, in fact there was no waste to it. No person tasted the meat without speaking of it. I was astonished at the amount of favorable comment it excited in regard to its tenderness and fine flavor. The poorest parts were better than ordinary choice cuts. The fats were good and profitable for use in cooking. Our pastry cook called it equal to butter.

"Next in order came the Galloway in quality and flavor and amount of edible meat; then the Hereford, the Holstein and the Devon in the order named; the Devon, in amount and flavor of the edible meat and quality of the fats, being equal to either of the other bullocks, except the Jersey, but lacking that tenderness found in the others. The Shorthorn was fine in flavor and tender as anyone could desire, but would be very unprofitable to the consumer. There was a very large waste in fats; much of what we call the corning pieces were so spongy and fat that we could not corn them or otherwise use them except to render them for fats which we could not use in cooking, and that is a product of little value to the consumer."

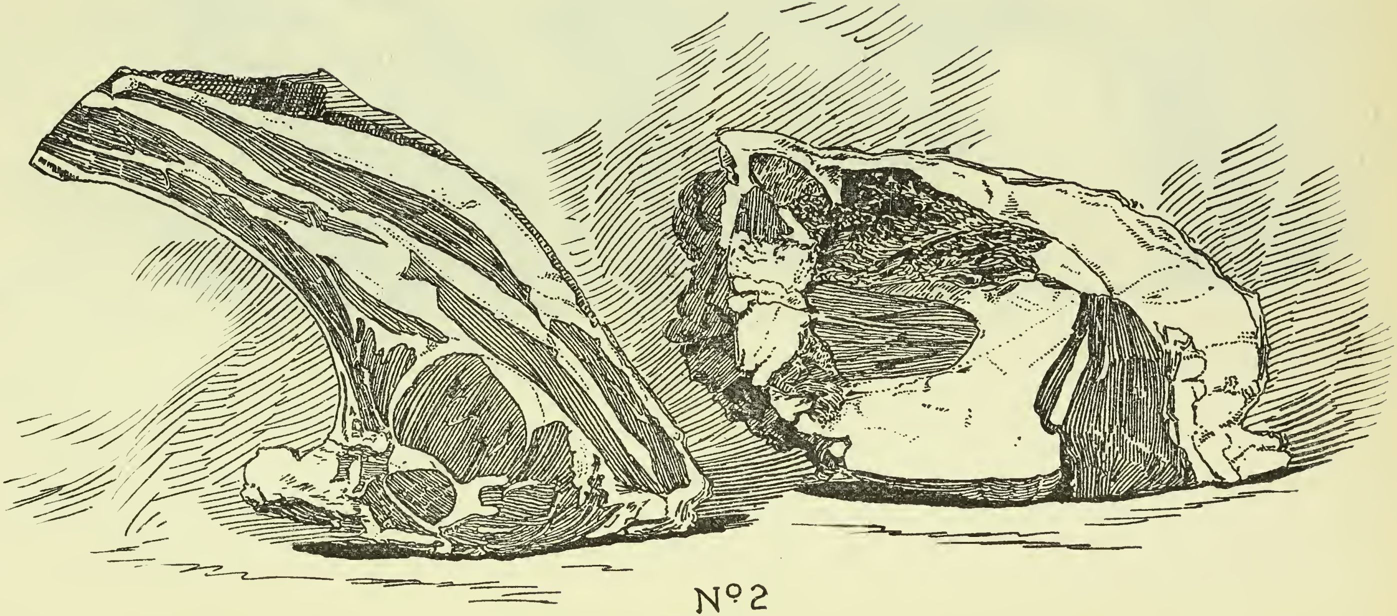
The following tables give the results of the three years' feeding in a summarized form, and in such connection, it is hoped, as will enable those inter-



№ 1

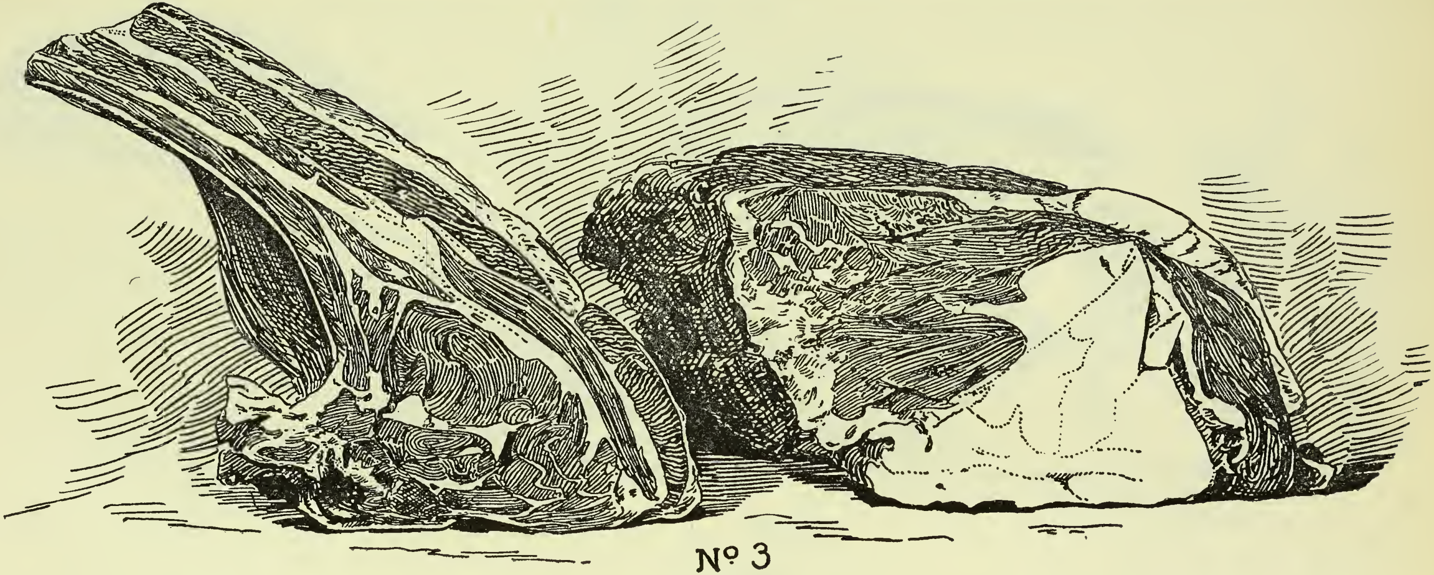
DEVON.

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS



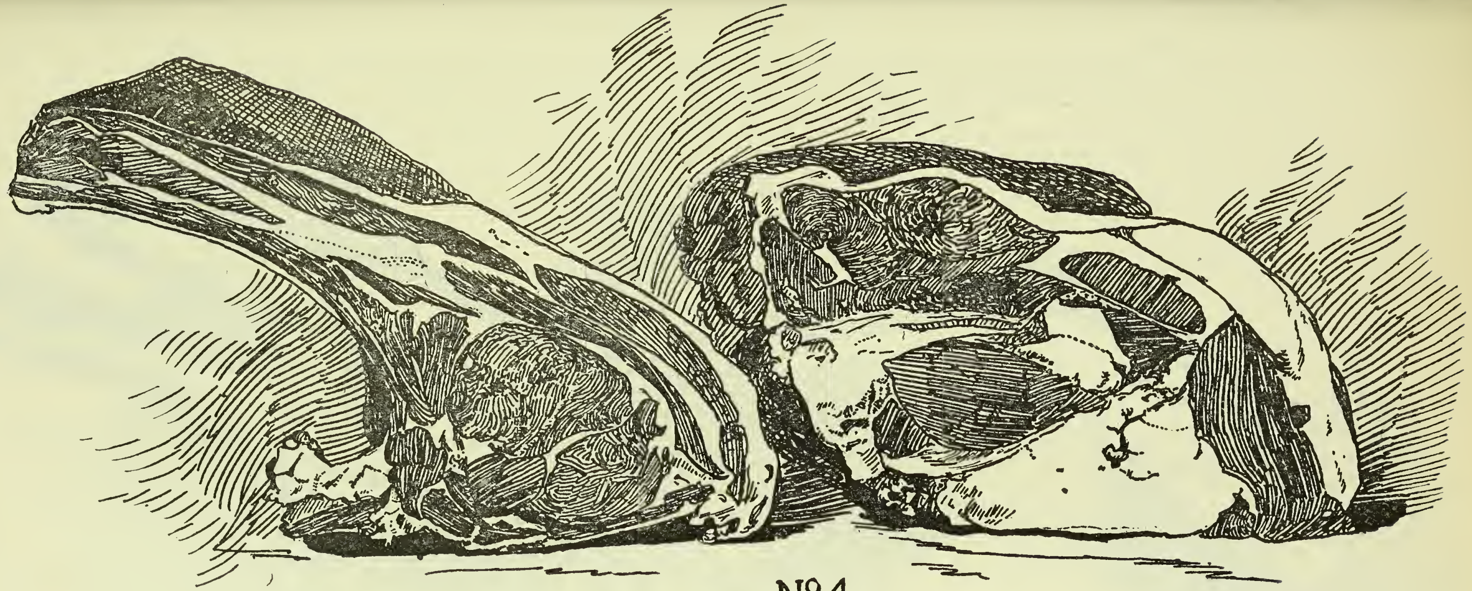
N°2
HERHEREFORD.

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS



Nº 3

JERSEY.



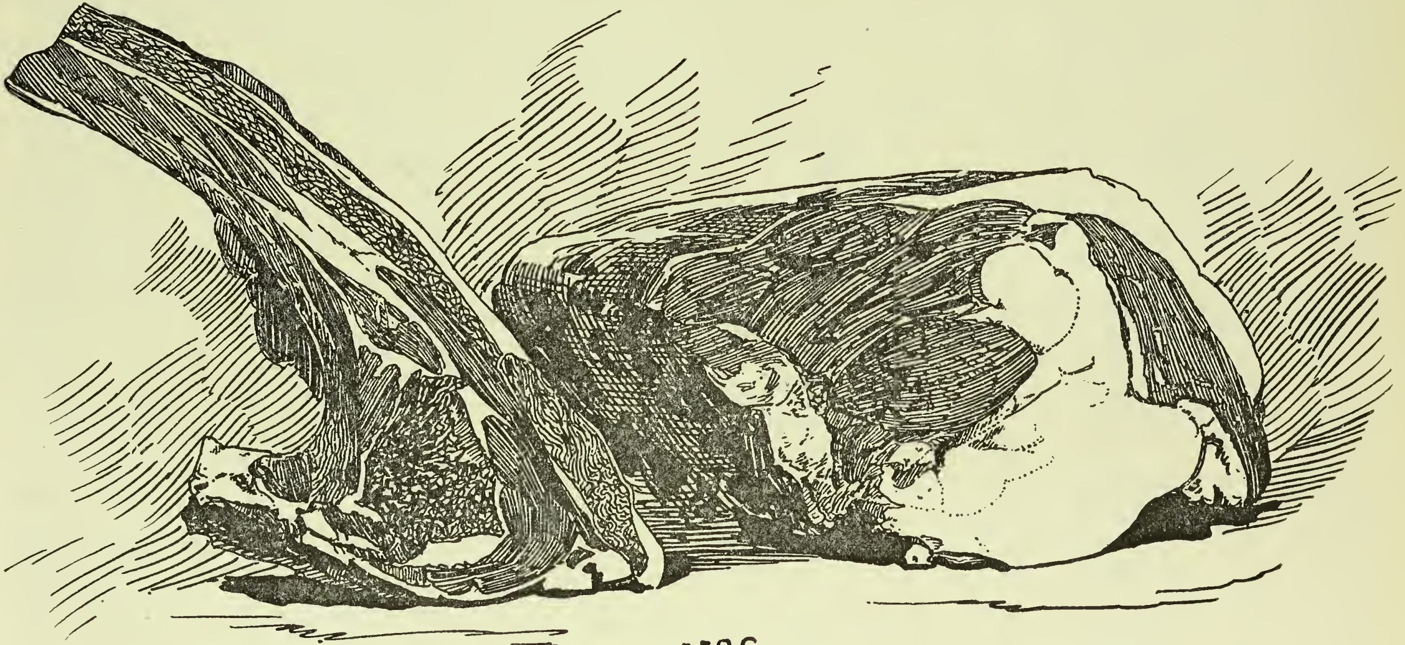
No 4

GALLOWAY.

Nº 5

SHORTHORN.

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS



N°6

HOLSTEIN.

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

ested in the cost of production of the different breeds, the daily and yearly gains, the per cent of dressed to live weight, and other important facts in this connection, to get by comparison a clear idea of the lessons which they teach.

The grain fed the last year, like that of the two preceding, has been largely wheat bran, oats and some oil meal, and to this more corn meal was added, especially during the last six months.

The grain is estimated in these tables at $16.00 per ton, being a combination of bran at $12.00; oats at from $15.63 to $18.73 per ton, or from 25c to 30c per bushel; corn at from $14.28 to $16.07 per ton, or from 40c to 45c per bushel, and oil meal at $27.00 per ton. Hay was estimated at $8.00 per ton, roots at $3.00 and ensilage at $3.00.

TABLE I.—*From birth to one year old, amount and cost of milk not computed.*

Breed.	Name of Animal.	No. lbs. Grain.	No. lbs. Hay.	No. lbs. Roots.	No. lbs. Ensilage.	Cost of Food.	Weight at 1 year.	Gain per day.	Cost per lb.	
Devon	Latitude	1,020	1,225	39	207	$13 43	521	1.42	.025	Calved Mar. 23,'86.
Hereford	Hendricks	652	609	......	......	7 65	705	1.93	.01	" Oct. 27, '85.
Galloway	King Jumbo	1,128	1,459	......	21	14 89	738	2.02	.02	" Feb. 17, '86.
Galloway	Judge	1,104	1,361	......	......	14 27	829	2.27	.017	" Jan 1, '86.
Jersey	Roscoe	1,041	847	......	15	11 74	571	1.56	.02	" Aug. 27,'85.
Jersey	Potter	1,467	938	......	30	15 54	568	1.55	.027	" Feb. 25, '86.
Holstein	Nicholas	1,288	1,430	......	54	16 11	731	2.00	.022	" Feb. 26, '86.
Holstein	Beltz	1,039	1,096	......	......	12 70	876	2.40	.014	" Nov. 17,'85.
Shorthorn	Homer	1,068	946	......	......	12 34	801	2.19	.015	" Nov. 25,'85.
Shorthorn	Holt	1,153	1,085	......	......	13 57	754	2.07	.017	" Dec. 17, '85.

This table gives the amount of the food consumed, the cost of the same, the weight of the animals at one year, gain per day for one year, and cost per pound for one year.

It will be noticed that the milk consumed is not computed in the cost. Some of the calves were raised on the pail, some ran with their dams. The cost of the milk varies in different localities, and as the calves were brought from various parts of the State, it was thought best to leave the cost of the milk, which at best could only be estimated, for each feeder to determine for himself.

The Devon was brought up on the pail; after two weeks old he was fed on skim milk.

Hendricks, the Hereford, on the other hand, was suckled by his dam, and not weaned until about 8 months old. He received some grain, and all the hay he would eat during this time.

The Galloway, Jumbo, the two Holsteins, and the Jerseys were brought up on the pail. The other Galloway and the Shorthorns ran with their dams.

A study of the table in regard to gains made may aid in answering the question, often asked, whether as good a calf can be raised on the pail as if allowed to run with the cow?

The Holstein, Beltz, made the greatest gain during the year, weighing 47 pounds more than the Galloway, King Jumbo, who comes next in weight; both were brought up on the pail.

The differences, in cost, of the so-called beef breeds and of those usually thought of value solely for the dairy, are much less than is generally estimated; the cost of the ten steers being quite uniform, with the exception of the Hereford, and, as has been stated, this was owing to his having been weaned later than any of the others, and so receiving more milk.

The cost per pound is quite uniform, one of the Jerseys having cost most, and one of the Holsteins least; excepting the Hereford, with one of the Shorthorns a close second.

It will be noticed that the animals of the same breed differ some in cost.

The greatest gain per day is by one of the Holsteins, while the Devon made the least. The individual gains of the same breeds are nearly uniform.

TABLE II.—*Cost and Gain for Second Year and Two Years.*

Breed.	Name of Animal.	No. lbs. Grain.	No. lbs. Hay.	No. lbs. Roots.	No. lbs. Ensilage.	Cost of Food.	Weight at 1 year.	Weight at 2 yrs.	Gain 2d year.	Gain per day 2d year.	Cost per lb. 2d year.	Gain for 2 years.	Gain per day 2 years.	Cost, 2 years.	Cost per lb., 2 years.
Devon	Latitude	2,329	3,051	1,678	153	$33 57	521	1,009	488	1.33	.068	1,009	1.38	$47 00	.045
Hereford	Hendricks	2,273	3,090	228	390	31 46	705	1,105	405	1.10	.072	1,105	1.57	39 11	.035
Galloway	KingJumbo	2,677	2,689	326	1,216	34 48	738	1,212	474	1.29	.072	1,212	1.66	49 37	.04
Galloway	Judge	3,059	3,645	503	390	40 38	829	1,343	514	1.40	.078	1,343	1.85	54 65	.04
Jersey	Roscoe	2,638	2,870	199	330	33 39	571	1,007	436	1.19	.076	1,007	1.38	45 13	.044
Jersey	Potter	2,461	3,105	102	1.335	34 25	568	1,048	480	1.31	.071	1,048	1.43	49 79	.047
Holstein	Nicholas	2,989	3,594	226	1,382	40 71	731	1,316	585	1.60	.069	1,316	1.80	56 82	.043
Holstein	Beltz	3,517	3,903	222	390	44 68	876	1,442	566	1.55	.078	1,442	1.97	57 38	.039
Shorthorn	Homer	3,157	3,741	226	390	41 25	801	1,367	566	1.55	.072	1,367	1.87	53 59	.039
Shorthorn	Holt	2,666	3,642	225	458	38 93	754	1,234	480	1.31	.081	1,234	1.69	52 50	.042

Table II carries the same items named in table I to the second year, and also gives some of the more important lessons for the two years.

Some questions as to the varying amounts of ensilage and roots consumed by the different animals may arise. The difference is accounted for, in large measure, by the differences in dates of birth, fall and winter calves not receiving any their first winter, while those born in the spring were so fed their first winter. The tastes of individual animals has also its effect.

It will be noticed that the cost of production is much greater this year. In all cases doubled and in some trebled.

In the cost per pound the first year, the greatest was 2.7 cents, while the lowest in the second year was 6.8 cents. The greatest is 8.1 cents.

TABLE III.—*Third year. Experiments closed Nov. 1, 1888. All under three years except Hendricks* and Roscoe†.*

Breed.	Name of Animal.	No. lbs. Grain.	No. lbs. Hay.	No. lbs. Roots.	No. lbs. Ensilage.	Cost of Food.	Weight at 2 yrs.	Weight Nov. 1.	Gain for 3d year.	Gain per day 3d year.	Cost per lb. 3d year.	Gain 2d and 3d years.	Gain per day 2d and 3d years.	Cost for 3 years.	Cost per lb. for 3 years.	Gain for 3 years.	Gain per day for 3 years.
Devon	Latitude	1,969	1,113	533	......	$21 00	1,009	1,270	261	1.19	.08	749	1.27	$68 00	.053	1,270	1.33
Hereford	Hendricks	2,922	2,898	......	1,759	37 62	1,105	1,424	319	.87	.117	719	.98	76 73	.053	1,424	1.30
Galloway	King Jumbo	2,906	1,555	1,047	......	31 04	1,212	1,620	408	1.60	.076	882	1.41	80 41	.049	1,620	1.64
Galloway	Judge	3,619	2,279	270	1,459	40 67	1,343	1,790	447	1.49	.09	961	1.43	95 32	.053	1,790	1.74
Jersey	Roscoe	3,114	3,401	717	1,255	41 48	1,007	1,383	376	1.03	.11	812	1.11	86 61	.062	1,383	1.26
Jersey	Potter	2,552	1,481	736	210	27 77	1,048	1,410	326	1.47	.076	842	1.37	77 56	.055	1,410	1.44
Holstein	Nicholas	3,023	1,663	735	196	32 22	1,316	1,660	344	1.40	.093	929	1.52	89 06	.053	1.660	1.70
Holstein	Beltz	4,223	3,434	267	1,701	49 47	1,442	1,870	428	1.23	.115	994	1.39	106 85	.057	1,870	1.73
Shorthorn	Homer	3,917	3,111	1,623	375	46 77	1,367	1,870	503	1.47	.105	1,069	1.51	100 36	.055	1,870	1.74
Shorthorn	Holt	3,556	2,649	1,633	224	41 84	1,234	1,670	436	1.38	.095	916	1.33	94 34	.056	1,670	1.59

* Hendricks to October 27.
† Roscoe to August 27.

TABLE IV.—*Hendricks and Roscoe, from three years old to Nov. 1, 1888.*

Breed.	Name of Animal.	No. lbs. Grain.	No. lbs. Hay.	No. lbs. Roots.	No. lbs. Ensilage.	Cost of Food.	Weight at 3 yrs.	Weight Nov. 1.	Gain.	Gain per Day.	Cost per lb.	Gain for Whole Time.	Gain per Day—Whole Time.	Cost for Whole Time.	Cost per lb.—Whole Time.
Hereford	Hendricks	117	53	......	......	$1 15	1,424	1,456	26	2.00	.044	1,450	1.32	$77 88	.053
Jersey	Roscoe	788	327	......	......	6 43	1,383	1,490	170	2.65	.037	1,490	1.28	93 04	.062

In this connection the decreased gain per day should be noted. During the first year six of the ten, or the Galloways, Holsteins and Shorthorns, each made two or over two pounds gain per day, the Herefords and Jerseys over one and one-half pounds, and the Devon almost as much.

During the second year but three made a daily gain of 1½ pounds or more. The Hereford, 1.1 lbs., the least.

Taking the two years together the showing is better. It should be remembered in this connection that the steers were fed this second year for growth, as we had planned to finish them the third year. Had they been fitted for the market at 24 months the cost per pound would have been greatly reduced.

The same items named in table one are carried to the third year in this table, III., and some lessons for the entire time are also found here.

It must be remembered that the periods named in this table differ, from a year for the Hereford and Jersey, Roscoe, and a less time for the others, depending on the date of birth.

The variation in cost of food is, in part, caused by this.

In the gain per day only one animal, the Galloway, King Jumbo, has made over 1½ pounds per day; the other Galloway almost as much. The Jersey, Potter, and the Shorthorn, Homer, next, while the Hereford gained less than one pound a day.

The cost per pound is large for the third year.

Considering the whole time fed, it will be noted that the cost varies, but not more than the weights.

The cost per pound also varies. The least cost being King Jumbo, 4.9c, and the greatest, Roscoe, 6.2c. per pound. The cost of the others runs from 5.3c to 5.7c per pound.

The gain per day ranges from 1.28 pounds per day, that of Roscoe, to 1.74 pounds per day, that of Homer.

The important points of this table, IV., are already noted under III.

It contains the data concerning Roscoe and Hendricks from the time they were three years old to the close of the experiment, November 1, 1888.

Only a few days in case of Hendricks and over two months for Roscoe.

TABLE V.—*Pounds net to gross weight. Weight of parts. Age in days, and gain per day from birth.*

Breed.	Name of Animal.	Live Weight at Slaughter—lbs.	Weight Dressed Carcass after hanging 36 hrs.—lbs.	Pounds Net to Gross Weight.	Weight in Pounds.												Age in days Nov. 13, 1888.	Weight Nov. 13, 1888.	Gain per day from Birth.
					Hide.	Tallow.	Blood.	Feet.	Head.	Tongue.	Liver.	Heart.	Lungs.	Paunch.	Guts.	Trimmings.			
Devon	Latitude	1,240	777	63	77	58	35	13	32	8	13	4	16	117	37	6	965	1,270	1.31
Hereford	Hendricks	1,430	927	65	85	60	33	15	30	8	12	4	14	131	35	6	1,112	1,415	1.30
Jersey	Roscoe	1,460	868	59	90	96	49	16	32	8	15	6	15	164	56	6	1,173	1,475	1.26
Galloway	King Jumbo	1,570	971	62	110	72	42	20	40	9	16	5	16	165	45	6	1,000	1,600	1.60
Shorthorn	Homer	1,810	1,210	67	100	84	52	20	38	10	15	6	18	155	43	5	1,083	1,825	1.68
Holstein	Nicholas	1,620	1,014	63	90	93	38	20	36	9	15	5	19	154	48	6	991	1,655	1.67
*Devon	Choice	1,745	1,142	65	97	82	46	19	38	9	16	6	18	142	44	11	1,377	1,750	1.27
*Hereford	Earl of Shadeland 14	1,880	1,279	68	120	70	38	18	39	9	15	7	13	177	46	8	1,052	1,930	1.83
*Hereford	Chance	1,440	917	63	98	43	48	23	35	10	12	5	15	155	32	8	963	1,470	1.55
*Shorthorn	Chief Brant	1,885	1,291	68	94	99	36	19	35	9	15	5	21	152	41	8	1,022	1,890	1.85
*Angus	Dot	1,495	1,040	69	86	73	31	17	25	8	11	5	17	110	34	8	863	1,515	1.75
*Sussex	Heasman	1,625	1,021	63	110	69	43	19	38	11	14	5	19	161	90	8	1,021	1,625	1.62

NOTE.—Those marked with a star (*) are prize steers of 1888, and are placed here for purposes of comparison.

It is of importance to know how much merchantable beef can be obtained from the different breeds. This is shown in table V., also the weight of parts.

Some of the prize steers of the show of 1888, slaughtered the same day the experimental steers were, are placed in the same table for purposes of comparison.

As far as possible, animals of about the same age as the College lot were chosen, that the comparison might be fair.

It will be noticed that the showing is very creditable to the experimental steers, especially when it is remembered that they were not fattened purposely for the show, and that they were at the fairs four weeks in September and October, 1888.

TABLE VI.—*Shrinkage in carcass after hanging 36 hours, and weight of dressed quarters.*

Breed.	Name of Animal.	Live weight at slaughter.	Waste.	Weight of carcass.	Weight of carcass after hanging 36 hours.	Shrinkage.	Right hind quarter	Right fore quarter.	Left hind quarter.	Left fore quarter.
Devon	Latitude	1,240	416	824	777	47	185	200	188	204
Hereford	Hendricks	1,430	433	997	927	70	217	246	221	243
Jersey	Roscoe	1,460	553	907	868	39	203	228	205	232
Galloway	King Jumbo	1,570	546	1,024	971	53	226	253	226	266
Shorthorn	Homer	1,810	546	1,264	1,210	54	282	318	281	329
Holstein	Nicholas	1,620	533	1,087	1,014	73	251	251	257	255

Table VI. is interesting as showing the number of pounds each carcass shrank after hanging 36 hours, and the weight of the quarters.

CONCLUSIONS.

1st. The experiment seems to indicate that there is but little difference in the cost per pound of raising steers of the different breeds under the same conditions. The superiority of the beef breeds rather lies in their early maturing qualities, which enables the feeder to turn them off, well ripened, at two instead of three years.

2d. That calves brought up on the pail, when properly fed, will make as much growth and be equally as valuable for feeding as if they were allowed to suckle their dams.

3d. That there is likely to be a wide margin of difference between the judgments of the feeder, the butcher and the consumer, when they pass upon the bullock in the live classes, in the carcass competition as well as in the testing of the edible qualities of the meat.

4th. That prejudice resulting from a lack of information may be, too often is, the basis of our estimates of the comparative value of breeds.

5th. That early maturing breeds may be kept until over ripe, thus lessening the value of the carcass for the consumer.

6th. The lesson is very emphatically taught that average native steers, weighing from 1,100 to 1,300 pounds at 3 years, or often much less, cannot be raised and fed with profit. Well bred steers weighing from 500 to 800 pounds more at the same age may be. The value of good blood for beef production cannot, then, be overestimated. It, only, can, with good care and skillful feeding, in these times and with the present markets, bridge the margin between loss and profit for the grower and feeder.

7th. That the quality of beef produced by a combined grain ration, in which wheat bran, oats and some oil meal form the principal part, is preferable to that produced by a corn ration exclusively. I believe these animals would have had a much less percentage of meat valuable to butcher and conumer if corn had entered largely into their grain ration.

8th. The lesson is plainly taught that early maturing breeds may be sold with most profit, perhaps, at one year, if pushed from the start.

The cost per pound of production is greatly increased with each succeeding year. Certainly under most favorable conditions they should reach the limit of profit at from 24 to 30 months at latest. This may be modified in ordinary feeding by the fact that the yearling steer will need more expensive food than older ones. The latter will consume more rough fodder profitably than the former.

9th. That the largest per cent of dressed to live weight does not always indicate the best quality of meat, nor the most profitable carcass for the dealer or consumer. So that the commonly received opinion, that the steer that shrinks least in killing is the best for the butcher, must be more or less modified by other conditions.

In concluding this final report the writer desires to express his sincere appreciation of the encouragement of the State Board of Agriculture, of the various cattle organizations and agricultural journals that have referred to our work, and to the State Legislatures which have appropriated moneys to carry on these experiments, the Hatch law only having been in operation a part of the last year.

While conscious that it was an untried field in experimental work, it seemed to me a very important one. Like all first essays in new fields, plan and execution of detail may not always have been the best. We can only say that we have aimed to do and have done in the most thoroughly conscientious manner, everything in connection with the experiment from beginning to finish. And it is no small satisfaction to feel and know, that however some breeders may have been disappointed in the results, no one has questioned in the remotest degree, so far as I know, the impartiality of the test. We offer this contribution to the cattle men and farmers of America, and hope there may be some lessons of real value for them in these reports.

One swallow doesn't make a summer, nor does one test prove the superiority of any breed.

It is only one (the first ever made) of a needed series of tests which shall enable us to give the average of results, and thus ultimately lead to something like a demonstration.

A prime lot of steer calves has been secured and are well started for a repetition of the test. We do not, at this writing, design to carry this second lot over 24 to 30 months, believing that profitable beef production means the securing of heaviest weight of merchantable beef at the earliest age possible.

Early maturity must be a prime factor in a profitable beef producer.

Suggestions will be thankfully received from those who are interested in this work.

SAMUEL JOHNSON,
Professor of Agriculture.

MICHIGAN AGRICULTURAL COLLEGE,
January 18, 1889.

NO. 45.—DEPARTMENT OF BOTANY AND FORESTRY.

WHY NOT PLANT A GROVE?

These few pages on forestry have not been written to secure the applause of those who see little use for a bulletin unless it contain some new truths brought out by conducting careful experiments. On the contrary, they have been prepared with the view to help awaken an interest in the subject by calling attention to a few simple facts in the plainest way possible, and then to give some elementary hints on the selecting, planting and management of young forest trees in groves and screens.

For the past ten years or more the lumber cut in Michigan has been steadily on the increase, and during this time the great waste has been without a parallel in the history of nations. In the southern counties of the State, people are already beginning to be more careful about wasting the timber.

The average capacity of the saw mills in Michigan is nearly one-fifth that for the whole United States. About sixty per cent of all the yearly cut of white pine in North America is taken from Michigan. Still, she has left much hard wood of certain kinds, though that is fast going into market. After all, we must admit that a timber famine is yet a long way off, but it takes a long time to recuperate in case of a shortage in the timber supply. Of the three greatest interests of our country, manufacturing of all kinds ranks first, agriculture second, and forestry third.

"The evidence is ample and conclusive that we are making fearful inroads on our forest stores. We are cutting off a much larger crop than can possibly be replaced by natural growth within the period when, at the present rate, we shall have cleared the original forest off the ground. We are wasting our forests by the ax, by fire, by pasturage, by neglect. So far as timber is concerned, we are eating into our capital with little care for the future."—Dr. E. J. James in Forestry Bulletin No. 2 of U. S. Agrl. Dept.

Congress has appropriated large amounts of money for investigating and encouraging the growing of oysters, crabs, lobsters and fish, and the money already appears to be giving large returns. Our own State for some years has done a little by way of experiment to foster the production of fish in our lakes, ponds and streams. We legislate to protect birds and wild game, and appropriate money to encourage a large number of worthy objects, but for "our forests, from which we are drawing a larger amount in natural wealth than from any other source of supply, or from all other sources together, we have so far done practically nothing to protect or cultivate."—Dr. E. J. James.

If something profitable cannot be done in connection with this great subject of forestry, then it is very unlike any other question of great importance.

We feel confident that there are many important points in connection with forestry which should constantly receive a good deal of thought from many of our best citizens.

Although late in the day, in 1887, Michigan began to give a little attention to this important subject by placing five hundred dollars a year in the hands of the State Board of Agriculture for making inquiries and investigations. In addition to this amount, the State pays for printing the reports. None of the money is used to pay salaries of the commissioners or the directors, who have accomplished a little already in addition to their regular work in other directions.

The writer is now supposed to be passing one of the thousands of good farm houses situated in any of the older settled counties of the State, when the following conversation ensues:

B. "I see the snow drifts have not yet all disappeared."

C. "No, and we haven't had much snow this winter either, and there has been less strong wind than for some years past. Generally, of late years, when there is a heavy fall of snow, it is soon so unevenly distributed that we have little idea of how much has fallen. It piles up along the north and south roads, and blows from some parts of the east and west roads. The wheat field has many bare spots, while in other places the drifts are deep."

B. "What do you suppose has brought about this change?"

C. "Since I cut off that piece of timber down there and brought to view the farms over west for a couple of miles, the wind has frequently swept over my fields with a great deal of force, sometimes making things fairly jingle, and when cold the air seems to penetrate the smallest cracks in my pens, sheds and barns. The pigs squeal, the cows give less milk, the horses shiver, and even the hen-coop is too freely ventilated. I believe the animals at such times eat more grain and fodder than they do when there is less cold air in motion. The house, too, gets colder in the night than it used to when there were few strong winds. I am sure I have to lay in a larger supply of firewood than I used to."

B. "You seem to take in the whole situation at a glance."

C. "I have seen many changes in my life. When I came to this neighborhood, much of the land was still covered with a dense virgin forest. As one block of woods after another disappeared, I noticed the winds became more frequent and penetrating, but what could I do? and what could my neighbors do? We needed the land to raise more wheat and to feed more stock, and we got something for the timber which helped to pay off mortgages."

B. "There is a partial remedy for checking the fierce winds which drift the snows in winter, shake the apples from the trees in summer, and lodge the grain before it is ripe."

C. "Yes, I know it. We can let the young trees grow up along the fences of our fields, and we can plant trees west of our farm buildings; but then it would be a great deal of trouble and cost a good deal to plant trees, and we should have to wait so long for any favorable results."

B. "The cost is much less than most persons imagine, and when once started, they keep growing year by year, and before you are aware of it, the little trees have grown upwards and spread outwards. Suppose you were to plow a strip a rod wide and ten or fifteen rods long either in a straight line, in a curve or in an irregular shape. That would not cost much. Then harrow it well, as though you were fitting the piece for corn."

C. "Then I should have to go to the woods and find some good trees, dig them, cart them to the house, dig deep holes, set the trees, stake them, mulch them, wait a while, see half of them die and the others would look pale and stunted."

B. "I think you could do better than that. Of course you must arrange the fences so as to keep cattle, sheep and horses away from young trees. Let us see about the plan for a wind-break or for a small grove. You can put in as many kind of trees as you like, the more the better, if you want to try experiments and think you would like to study them and learn their habits, but if you want trees that will grow fast, that are likely to remain healthy and furnish protection, you need only one, two or three species which are the best adapted for the purpose. We can't afford to go to the woods and dig trees. We can buy them cheaper."

C. "Buy them! Why, a nurseryman will charge me twenty-five to fifty cents apiece for his evergreens. I can't afford that."

B. "Procure small trees; they will cost much less; they can be more easily planted; will be more likely to live, and after a few years they will very likely catch up and overtake trees which were larger at the time of planting. The foundation of your screen will consist of evergreens. If others are added which are not evergreens, they should not be put in blocks each sort by itself, but mixed more or less in checker-board style with the evergreens. And the evergreens may as well be mixed if no others are planted. You will want to set them in rows, straight, curved or crooked in one way four feet apart and three or four feet apart in the row, so they can be as easily cultivated one way as corn or potatoes. There is little risk in setting too thickly, and the trees will sooner shade the ground.

"R. Douglas & Sons, Waukegan, Illinois, will send by mail:

"White pines, 3 years old, @ $1.00 per 100, or $8 per 1,000.

"Norway spruces, 3 years old, @ 75 cents per 100, or $6 per 1,000.

"At about the same price you can procure any or all of the following: European larch, white ash, American elm, black cherry, black locust and many others, remembering that for good screens, half or more of the trees should be evergreens rather equally distributed over the ground. W. W. Johnson, Snowflake, Antrim Co., Michigan, will doubtless send young trees at the above prices. A single row or two rows will make a good screen, but you will be better pleased with a wider strip of trees."

C. "I will send a postal card right away and get the price lists from these two men. It won't cost much to start a screen in that way. Tell me more about setting the trees, as you seem to know concerning such things."

B. "The trees arrive about the time you are sowing oats. Open the packages, and place the roots in damp soil in the shade, not forgetting that the roots of trees are unfitted by nature to stand the air. In the wind or the sun or in dry air, or in the open air roots will live just about as long as a black bass will live out of water; not much longer. Prepare some thin mud in a pail, filling it a third full. In this mud place the roots of the trees, one sort at a time. Of course you have staked or marked out your ground. Dig a small hole with a spade and let the boy drop a tree in the hole; straighten it up; replace the soil, not omitting to step your full weight with one foot each side and near each tree before leaving it. This is important, as it packs the soil close to the roots, helping it to retain moisture, and preventing the air from entering. One after the other, all the kinds are planted."

C. "Then what?"

B. "If you are now careless and lose all your interest in the subject, and keep busy at something else, you will very likely leave the young things to look out for themselves. The grass and weeds will choke them, and your little enterprise will cause deep regret every time you think of it, and prove the laughing stock of all your neighbors."

C. "I am not that kind of a farmer to drop a thing before I give it a fair trial."

B. "Then you will cutivate this land as you do your best cornfield, with level culture, only continue to cultivate all summer."

C. "What shall I do next?"

B. "Keep on cultivating during succeeding years, as long as a horse can get through the rows, perhaps four or five years or more, then the trees will not need it any longer. From time to time you will very likely pick up some other kinds of very small trees, or shrubs from the neighboring woods, and set them in among the others in the grove. If the cultivation is attended to, and the land is not too wet, you will be surprised at the rapid growth of the trees.

C. "Why can't I mulch the ground all over with straw from the old stack and save all further trouble?"

B. "It is not a good plan, and if you try it you will be disappointed. Cultivation is much better, and with the trees near the house, it is but a light chore to cultivate each time. If blackwalnuts, chestnuts, butternuts, hickories and oaks are desired in any places, plant the nuts where the trees are to remain."

C. "Thank you. I feel sure now that I understand the plan. It is so much cheaper and easier than I had supposed that I am going to plant a grove; even a small one started this year will be much better than a larger one long delayed and perhaps never planted.

B. "In older States like Massachusetts, farms already bring a better price if they contain some suitable groves or lots of young thrifty timber. As the grove improves with age, you will be reading every good thing you can get on forestry. You will take a deeper interest in the work of the State Forestry Commission. You will want to see their last report and all that may be issued in the future. You will have a good right to consider yourself as one of Michigan's most enterprising farmers. You will be planting for study as well as for producing a grove to shield animals or growing crops from the severe winds. You will be an experimenter, a pioneer in a good cause, and the longer you live the more you will see the importance of a knowledge of forestry.

"What is the custom in this neighborhood in regard to pasturing wood-lots?"

C. "Every one turns in his cattle, sheep, horses and hogs, or one or more kinds of these animals. It affords some feed, and cleans out lots of rubbish and makes the woods look like a park."

B. "Yes, and it lets in the light, and with the light grasses will slowly creep in affording more pasture, to be sure, but this will check the growth of larger trees, and small trees are not allowed to follow on to take their places. The man who has much interest in the future of his reserve timber lot will not use it for a pasture."

Reader, if not already done, will you not plant a grove this year, or do something to induce some of your friends to plant one? The writer will be glad to give any further instructions in his power on this subject, and would consider it a favor to receive a postal card from any who contemplates a grove.

Dr. W. J. BEAL,
Prof. of Botany and Forestry,
and one of the Directors of the State Forestry Commission.

March 20, 1889.

NO. 46.—FARM DEPARTMENT.

POTATOES, ROOTS, FERTILIZERS AND OATS.

POTATOES.

The soil on which the potatoes were grown was a sandy loam, which had been seeded five years and used for a meadow.

The sod was heavy, containing June grass and Timothy with little clover.

The plats received a good dressing of barn-yard manure before plowing. The land was plowed seven inches deep, thoroughly harrowed with a spring-tooth harrow, and marked with furrows four inches deep and three feet apart each way, making 4,840 hills to the acre. This method of marking both ways is necessary to insure the same number of hills in each plat without the tedious method of counting each hill. No doubt larger yields might be secured if planted in drills.

The potatoes were cut in pieces, having from three to four eyes each, and one piece placed in each hill. The seed was covered with about four inches of earth, and then the whole field was rolled with a two-horse roller. This firms the earth around the seed, and unless the ground is very heavy, will aid in starting the seed to grow. If the ground is sticky and wet, a crust will be formed by rolling, which is not desirable.

The plants came up very uniformly. In rows containing 100 hills there would be no perceptible difference in the time of the appearance of the sprouts above the ground. This is important, for if there is a hill a little later than its neighbors, the potato beetle is sure to attack it in preference to the more vigorous plants.

The "Iron Age" five-tooth cultivator was used to tend the potatoes until the vines became too large to allow it to pass between the rows, when the double shovel cultivator was substituted, passing once in a row. We aim to give level cultivation so far as possible. Some raise the objection that the potatoes will sun-burn if not hilled up; but the balance of evidence is just the reverse, and the potatoes will not suffer from drought as badly when the ground is kept level. Plant deep and keep the ground level.

The potato beetles were as numerous as ever; but they are no longer a terror to potato growers, however great a nuisance they may be. We used "Hermes' Sprinkler" in applying Paris green, and were much pleased with it. It is carried on the back, contains three or four pails of water, and will sprinkle two rows at the same time.

In Table 1 we give the yield of eighteen varieties grown in 1887, for the sake of comparing with the results of the past year. The yield was very much less in 1887, owing to the severe drought which prevailed during the entire season. In the column showing the per cent of small potatoes, it will be seen that there is quite a variation. Some of the varieties, such as Nos. 9, 10, 12, 13, 15, 17, were very uniform in size, and are among the standard sorts which have been grown on the College farm for several years. No. 17 gives the smallest per cent of small potatoes, also an aggregate yield nearly equal to that of the best. No. 9 has also proved itself a very good medium early sort. It is earlier than No. 17. No. 15 is another medium early variety which is among the most promising. Of the late varieties, Nos. 10 and 11 stand at the head. No. 12 has always given a good yield, but its quality is not equal to some others. Nos. 21 and 23 are very much alike in manner of growing and in shape of tuber. The quality of both was very poor, and they were badly affected with scab. No. 23 ripened earlier than any other variety. Nos. 13 and 27 resemble each other very much (are probably identical. No. 25 is a very handsome potato; but as only one small potato was planted we are unable to judge of its merits. No. 28 is a variety sent out by the Department of Agriculture with no name. From two potatoes we made forty hills which produced two distinct varieties of large tubers, one white and the other flesh color, the latter differing in shape from the former. It is possible that the two potatoes received represented two distinct varieties, but they did not indicate it.

TABLE NO. 1.—*Potatoes. Comparative yield of varieties.*

Name of Variety.	No. of plat.	Date of planting.	Date of harvesting.	Early, medium or late.	Size of plat.	Yield of plat. Bushels.	Per cent of small potatoes.	Yield per acre in 1887. Bushels.	Yield per acre in 1888. Bushels.
Beauty of Hebron	1	May 10	Sept. 5	E	1-8 acre.	18 1-3	8	134	146
Clark No. 1	2	"	" 6	"	1-13 "	11 1-3	7	109	147
Vick's Extra Early	3	"	" 21	"	1-8 "	16 1-7	19	69	129
Lee's Favorite	4	"	" 21	"	1-8 "	16 2-15	7	98	129
Polaris	5	"	" 22	"	1-20 "	6 5-6	11	80	136
Early Harvest	6	"	" 22	"	1-8 "	17	9	90	136
Early Telephone	7	"	" 24	"	1-8 "	17 1-2	12	85	140
Early Mayflower	8	"	" 24	"	1-8 "	17 1-4	10	98	138
Chicago Market	9	"	" 24	M	1-8 "	17 1-6	4	118	137
White Star	10	"	" 28	L	1-8 "	19	3	126	152
Dakota Red	11	"	" 28	"	1-8 "	17 4-5	8	129	142
Rural Blush	12	"	" 28	"	1-8 "	19 1-2	6	92	156
Burbank Seedling	13	"	" 28	"	1-8 "	17 3-5	4	55	141
Thorburn	14	"	" 28	M	1-8 "	17 3-5	11	129	141
Alexander's Prolific	15	"	Oct. 1	"	1-8 "	20 1-3	5	120	162
Mammoth Pearl	16	"	" 1	L	1-8 "	19 5-6	6	118	158
White Elephant	17	"	Sept.28	M	1-8 "	19 9-10	3	112	159
Garfield	18	"	" 24	"	1-8 "	15 4-5	9	66	126
Early Maine	19	"	" 22	E	1-13 "	7 4-5	16	-----	96
Pearl of Savoy	20	"	" 22	"	1-13 "	10 7-10	15	------	139
Ohio Junior	21	"	" 22	"	1-13 "	10 1-5	16	------	132
Empire State	22	"	" 22	M	1-13 "	9 9-10	9	------	128
Early Ohio	23	"	" 6	E	1-13 "	7 13-15	13	----	102
Watson's Seedling	24	May 11	Oct. 1	M	1-20 "	8	6	-----	160
Rural New Yorker, No. 2	25	"	Sept.28	"	10 hills.	1-4	-----	------	137
Wall's Orange	26	"	" 28	L	48 "	1 9-10	------	------	193
Rochester Favorite	27	"	" 28	"	48 "	1 1-2	------	-----	150
Nameless	28	"	" 28	"	40 "	1 1-3	------	-----	161

Table No. 2 shows the results with different amounts of seed. The yield of the plats for four successive years is given, together with the average total yield and the average per cent of small potatoes during the same period.

While there is a larger average yield from the whole potato, there is a much larger per cent of small potatoes. The next largest per cent of small potatoes is found in the one eye plat, and the smallest in the yield of the three eye plat. So far the results go to strengthen what we have always claimed, that a medium amount of seed is better than a whole potato or a potato cut to single eyes. The whole potato produces too much growth above ground, and the one eye does not give quite vigor enough, especially if the weather is unfavorable. There was a marked gradation in vigor of growth from the one eye up to the whole potato. Where one eye was planted the potatoes came up very unevenly and some of them failed to grow, proving that it is unwise to take the chances of securing a good crop from such planting. Unless the soil contains a considerable amount of moisture the pieces will become dry before they can send out roots and thus fail to grow. In 1887 nine per cent of the seed cut to one eye failed to grow. The beetle injured the one eye plat more than the others, from the fact that the plants were not so vigorous.

TABLE NO. 2.—*Potatoes. Yield from seed cut various sizes.*

Amount of seed in each hill.	No. of plat.	Date of planting in 1888.	Date of harvesting in 1888.	Pounds.					Average per cent of small potatoes for 4 years.
				Yield in 1885.	Yield in 1886.	Yield in 1887.	Yield in 1888.	Average yield for 4 years.	
From one eye	1	May 5	Sept. 29	104	144	50	162	115	20
From two eyes	2	"	"	144	253	71	172	160	16
From three eyes	3	"	"	186	197	86	212	170 1-4	13
From one-half potato	4	"	"	182	227	90 1-2	168	166 4-5	18
From one whole potato	5	"	"	188	193	117 1-4	232	182 1-2	24

In the experiment with different kinds of fertilizers—table 3—the potatoes were cut to three eyes and planted with the Aspinwall potato planter. The machine has a fertilizer attachment which works very nicely. The planter is arranged so that the seed is dropped in a furrow made by the machine and the fertilizer is distributed very evenly over the row after some dirt has fallen over it; and then the machine covers the whole with more dirt, leaving the seed in the soil at the depth of about four inches. The depth of planting can be regulated by the operator. Not knowing just how much seed the planter required, we failed to have enough of the Beauty of Hebron and were compelled to take another variety to test the salt and plaster. Unleached ashes and Mapes' Potato Fertilizer were applied at the rate of 400 lbs. per acre; salt, 300 lbs.; plaster, 200 lbs.; 400 lbs. mixture made up as follows: Salt, 150 lbs.; plaster, 100 lbs.; ashes, 150 lbs. In the case of rows Nos. 2 and 3 there was no difference in the yield.

The potato fertilizer seems to stimulate the growth of vines somewhat, but further than that there was no perceptible difference. The ashes alone did not give as good results as we might expect, but it is possibly due to their being too strong to apply to the hills in this way. Where the Thorburn variety was planted plaster gave much better results than the salt, which was a positive injury. Probably salt would have given better results had it been sown broadcast and thoroughly worked into the soil. It would not have injured the vines at least. The increase over the yield where no fertilizer was applied would hardly warrant the purchase of commercial fertilizers, other conditions being favorable.

Table No. 4 gives the results where potatoes were planted in furrows by hand. In plat No. 1 the potatoes were cut to three eyes and one piece placed in each hill. The seed was covered with about two inches of dirt, and Mapes' Potato Fertilizer was applied on the hills at the rate of 400 lbs. per acre. The hills were then covered with two inches more of dirt, making about four inches of earth over the seed. In plat No. 3 the potatoes were cut the same as in the first plat, and seed rolled in plaster, taking up all that would adhere. In plat No. 2 the same conditions prevailed, except there was no fertilizer.

In the notes taken during the season, frequent mention was made of the increased vigor of growth where plaster and potato fertilizer were used. In the yield there is a slight increase in favor of the potato fertilizer, but not enough to warrant the extra expense incurred in its purchase and application. Such an experiment must be continued for a series of years to obtain reliable data.

The yield of the potato crop was not large, owing to severe dry weather before the potatoes had matured. The growth during the fore part of the season was remarkable, but later, by lack of rain, the yield was materially lessened. In quality the tubers were very good and entirely free from rot. Some of the varieties were affected with scab, but not so badly as in some former years. It attacked the potatoes worse where the ground was richest and inclined to be heavy. The potatoes in the more tenacious soils and in the low places were most affected.

TABLE NO. 3.—*Potatoes. Effect of fertilizers.*

Variety.	No. of plat.	Date of planting.	Date of harvesting.	Size of plat.	Yield of plat. Pounds.	Yield per acre. Bushels.	Kind of Fertilizer.
Beauty of Hebron	1	May 11	Oct. 2	1 row	196	130	Ashes, unleached.
"	2	"	"	"	250	166	Mapes' potato fertilizer.
"	3	"	"	"	250	166	Mixture { Salt. Plaster, Ashes.
"	4	"	"	"	210	140	No fertilizer.
Thorburn	1	"	"	"	390	260	Plaster.
"	2	"	"	"	110	73	Salt.
"	3	"	"	"	360	240	No fertilizer.

TABLE NO. 4.—*Potatoes. Effect of fertilizers.*

Variety.	No. of plat.	Date of planting.	Date of harvesting.	Size of plat.	Yield of plat. Pounds.	Yield per acre. Bushels.	Kind of Fertilizer.
Burbank seedling	1	May 5	Oct. 3	125 hills	230	153	Mapes' potato fertilizer.
"	2	"	"	"	190	126	No fertilizer.
"	3	"	"	"	200	133	Plaster.

The following table is compiled exclusively from American analyses. In the first column is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is desirable to know within what limits the composition of the roots is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

It is placed here because of its value for reference in the study of the root crops especially.

[From Composition of American Feeding Stuffs, by Dr. E. H. Jenkins of the Connecticut Experiment Station—Report of 1887.]

Composition of Roots, Tubers, other Vegetables and Fruits.

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen—Free Extract.			Fiber.			Ash
		Min.	Max.	Av.	Min	Max	Av.	Min	Max	Av.	Min.	Max.	Av.	Min	Max	Av.	
Beets, red	2	10.5	12.3	11.43	1.5	1.7	1.60	.2	.2	.18	7.2	7.6	7.40	.6	1.7	.12	1.08
Beets, sugar	8	9.2	16.4	13.03	1.7	2.9	2.01	.1	.2	.10	5.7	12.0	9.15	.7	1.1	.87	.90
Mangolds	6	5.6	11.7	8.68	1.0	1.9	1.52	----	.5	.16	2.4	8.4	5.00	.8	1.0	.84	1.16
Rutabagas	1	-----	-----	12.92	----	----	1.15	----	----	.09	-----	-----	9.11	----	----	1.16	1.41
Turnips	2	7.6	8.2	7.92	.8	1.3	1.02	.1	.2	.18	5.8	4.2	5.03	.8	1.2	1.01	.68
Carrots	6	8.9	13.5	11.70	.9	2.0	1.16	.2	.7	.42	5.1	10.4	7.68	1.0	2.3	1.38	1.06
Potatoes	7	19.4	24.1	21.90	1.1	3.0	2.19	----	.2	.10	15.3	20.0	18.19	.3	.9	.54	.88
Sweet potatoes	5	26.6	34.0	29.37	.5	3.6	1.55	.3	.6	.38	18.0	29.7	25.09	.6	2.5	1.36	.99
Cabbage	2	6.5	10.2	8.28	1.8	2.0	1.95	.2	.5	.33	2.0	3.5	2.75	1.4	3.0	2.21	1.04
Squash	2	4.8	5.4	5.12	.6	.6	.66	.2	.3	.28	2.9	3.5	3.24	.5	.5	.54	.40
Pumpkin	1	-----	-----	7.73	----	----	1.11	----	----	.16	-----	-----	4.34	----	----	1.49	.63
Apples	5	15.9	22.7	18.22	.2	1.2	.69	.3	.6	.41	12.6	20.0	15.31	.9	2.9	1.49	.32

CARROTS.

In the experiments with the different varieties of roots we have aimed to secure a few new sorts and grow them alongside those which have proved to be of real merit here. The Long Orange carrot has been our standard variety grown for stock for several years. The White Belgian, Danvers and Short Horn were grown last year, with results as shown in the table. The White Belgian gave a larger yield than the Long Orange, but does not seem to have the substance of the latter. The opinion is based on the appearance of the roots and not on the results of an analysis. Both are good keepers. The Danvers and Short Horn do not yield heavy enough to grow for feeding purposes, although they are fine in quality and somewhat earlier than the first named varieties.

SUGAR BEETS.

Of the sugar beets there is not much difference in the appearance of the two sorts grown; but quite a difference in yield in favor of Lane's Improved. This sort has been grown on the college farm for several years. It is reliable and a good yielder. It is more easily harvested, from the fact that the tops do not grow so close to the ground. The crown is well above ground so that it can be pulled easily. Vilmorin's is said to contain the highest per cent of sugar of any known variety. Sugar beets are much relished by stock, and are good keepers. They do not harvest so easy as the mangels, from the fact that they carry more fine roots and thus hold the dirt more thoroughly. No doubt they are richer in nutritive qualities.

MANGELS.

Of the mangels, the Golden Tankard has been our standard variety for several years. It is of medium size, between the Globe and Mammoth Tankard in shape, and a rich yellow in color. It is a good keeper, yields well, and is of better quality than some of the larger roots. No. 1 is a Yellow Globe and of good quality. No. 2 is shaped like the Tankard, but is coarse and has not yielded so well as that sort this season.

RUTABAGAS.

Of the rutabagas, there is not much choice in the first three varieties. They are yellow in color and all good yielders. In quality they are good for the table or for stock. The White Russian gave a fine yield, but carries a mass of fine roots which hinder in harvesting, as the soil adheres to them so closely. Its keeping qualities might be impaired for this reason, especially when harvested in damp weather.

TABLE 5.—*Roots. Yield.*

Name of Variety.	No. of plat.	Date of sowing.	Date of harvesting.	Size of plat.	Yield of plat. Bushels.	Yield per acre. Bushels.
Carrots:						
White Belgian	1	May 16	Oct. 24	2-25 acre	30.5	381
Danvers	2	“	“	2-25 “	20.9	260+
Short Horn	3	“	“	2-25 “	20.8	260
Long Orange	4	“	“	4-25 “	59.5	372
Sugar Beets:						
Vilmorin's	1	May 17	“	3-20 “	65.5	436
Lane's Improved	2	“	“	1-5 “	100.9	504
Mangels:						
Kniver's New Mangel	1	“	Oct. 25	3-20 “	76.6	510
New Red Fleshed	2	“	“	3-20 “	70 5	470
Golden Tankard	3	“	“	1-20 “	30.2	604
Rutabagas:						
Skirvings	1	June 19	Oct. 26	1-10 “	53.3	533
American	2	“	“	1-10 “	54.7	547
Yellow Swede	3	“	“	1-10 “	52.5	525
White Russian	4	“	“	1-20 “	25.3	516

In the experiment with different kinds of fertilizers the conditions were the same throughout. The fertilizers were applied on the rows, after the seed was sown, and raked into the soil.

The plat where the mixture of salt, plaster and ashes was applied, gives a slight increase in yield over the other fertilized plats, but not over the plat where no special fertilizer was used. The salt and mixture proved too strong for the young plants. They would no doubt have given better results had they been thoroughly worked into the soil before sowing the seed. The ashes alone gave better results than Mapes' Fertilizer.

The ground on which the roots were grown was a sandy loam. It received a heavy dressing of barn-yard manure, and was in good mellow condition. The seed was sown in drills three feet apart. Cultivation was with the "Iron Age" five-tooth cultivator and by hand hoeing. We thin the plants from eight to twelve inches apart in the row. While we do not think the average farmer, with dear labor, can afford to raise a large acreage of roots, we do hold to the opinion that a small area devoted to this crop will prove of great advantage in the feeding of stock.

Young animals are always more or less fastidious, requiring a frequent change in their rations to insure the best results. A few roots will prove beneficial. There is no stock that will not appreciate them.

TABLE 6.—*Roots. Fertilizers.*

Name of Variety.	No. of plat.	Date of sowing.	Date of harvesting.	Size of plat.	Yield of plat. Bushels.	Yield per acre. Bushels.	Kind and amount of Fertilizer per acre.
Golden Tankard......	1	May 17	Oct. 25	1-20 acre	27.3	546	400 lbs. salt.
"	2	"	"	"	26.8	536	400 lbs. Mapes' potato fertilizer.
"	3	"	"	"	29.6	592	300 lbs. mixture { Salt, Plaster, Ashes.
"	4	"	"	"	28.3	566	400 lbs. ashes.
"	5	"	"	"	24.2	484	200 lbs. plaster.
"	6	"	"	"	30.2	604	No fertilizer.

OATS.

In growing several varieties of oats only two were in plats large enough to warrant any computation of yield. The yield of those two varieties, Pringle's Progress and New Race Horse, fell a little below 38 bu. per acre, the former giving a slight increase over the latter.

All that was said last year in Bulletin No. 34, as regards the similarity of certain varieties, has been strengthened by the experiments of the past season. There are several varieties of the barley oat, such as Nos. 1, 2, 4, 5, 6, 15 and 16, that bear a very close resemblance. Nos. 1 and 4 grow a little coarser straw than the others, and do not ripen quite so evenly. The above are all very heavy varieties, weighing 36 to 42 lbs. per bushel, but they do not yield equal to our common white oat. The Welcome has been badly affected with smut for two years, while other varieties grown contiguous to it have not. It does not stand up as well as some of the others. Some of the varieties have not been grown long enough and on large enough area to enable us to form a definite opinion regarding them. The Welcome has been grown in the field for two years beside the common white oat, which is our best sort.

No. 3 was grown last year on a one-half acre plat and made a good growth of straw and size of head, but the yield was not enough to warrant any indorsement. It is an early oat; but the grain is not so plump and heavy as some of the barley oats. No. 7 is the earliest variety grown—was headed June 20th, 49 days from date of sowing. It is not a desirable variety from the fact that the straw is very fine and apt to lodge. No. 18 was grown last year for the first time and can not be readily distinguished from No. 15. Great yields are claimed for it; but, as in the case of most of the extraordinary yields, the conditions were extraordinarily favorable. Do not take for granted all that seed catalogues and enthusiasts say, but determine by thoroughly testing a few varieties which are adapted to the conditions of your locality. Grow the variety long enough and in large enough area so that there will be no sudden dropping off in the yield in passing from the plat to the field.

That many of the so-called new varieties have merit, and that the farmer can receive much good from changing seed occasionally there is no doubt; but go slow with the novelties, especially the marvelously yielding sorts.

BARLEY.

Two varieties of barley were grown last season, the Manshury and the Chevalier. The former is a six-rowed variety with large heads, stiff straw and heavy grain. It is a little later than the common six-rowed barley or the Chevalier. The yield was 40 bushels per acre. The Chevalier is a two-rowed variety, said to have originated in Scotland. The straw is not so strong as that of the Manshury and the heads are not as well filled, although they are somewhat longer. It yielded 36 bushels per acre.

TABLE 7.—*Oats.*

Name of Variety.	No. of plat	Date of sowing.	Date of ripening.	Color of grain.	Remarks.
New Race Horse	1	May 2	July 25	White	Barley oat.
White Seizure	2	“	“	“	Barley oat.
Pringle's Progress	3	“	“	“	Straw strong, heads large.
Monarch New Zealand	4	“	“	“	Barley oat. Good length of straw.
White Victoria	5	“	“	“	Barley oat. Good length of straw.
Short Club	6	“	“	“	Barley oat. Short straw.
Harris	7	“	“ 19	Dark	Narrow leaves and fine straw.
Millard's Kansas	8	“	“ 27	“	Straw very short.
Waterloo	9	“	“	“	Straw very short.
Black Russian	10	“	“	Mixed	This oat has become nearly pure white.
Florida	11	“	“	Dark	Very grassy appearance.
Yellow Etherian	12	“	“	Yellowish	Straw fine and slender.
White Russian	13	“	“ 30	White	Later than any other.
Norwez	14	“	“ 27	Dark	Very poor oat.
Clydesdale	15	“	“	White	Barley oat.
Welcome	16	“	“	“	Barley oat, quite smutty.
Potato Oat	17	“	“	“	Barley oat, very heavy.
White Scottish	18	“	“	“	Barley oat, very heavy.

The experiments reported in this bulletin were in part planned by H. T. French, my assistant, and conducted largely under his supervision, He has also compiled, in good part, the details of the recorded work herewith presented.

SAM'L JOHNSON,
Prof. of Agriculture.

Agricultural College, Mich., March 16, 1889.

NO. 47.—FARM DEPARTMENT.

SILOS AND ENSILAGE.

I. Seven years' experience with Silos and Ensilage at the College Farm.
II. Views of Prominent Farmers of Michigan on Ensilage.
III. Experiments with Ensilage vs. Corn harvested in the ordinary manner.
IV. Comparative test of varieties of Ensilage Corn.
V. Forage plants, Lucerne, Orchard grass.

Our experience with ensilage on the College farm dates from the year 1881, when the State legislature made a special appropriation of $1,000 "for the purpose of conducting experiments with ensilage for the feeding of animals, by the farm department of the Agricultural College." To Hon. J. S. Estabrook, of Saginaw, and Hon. Thos. Mars, of Berrien, chairmen of the House and Senate committees on the College, the credit is largely due of securing this appropriation, which made it possible for us to give this new method of preserving fodder crops some attention, especially at that stage in its history when it had very few advocates among agricultural teachers and writers, and when a majority of farmers were inclined to think it one of the most visionary and foolish suggestions ever made in the name of agricultural progress. A small silo was built in the basement of a grain barn then in process of erection, so that it might be utilized as a root cellar if the ensilage should prove a failure. So far as I am aware this was the first silo in Michigan.

Our experience with ensilage has been very satisfactory and our verdict of approval has been more and more confirmed with each succeeding year, as reference to our reports of the last eight years will show. Large silos have been erected and we now depend on ensilage for a good portion of our winter's food for our stock.

Seven years of experience have taught us some things about the silo and the questions that relate to it. But while there can be no doubt of the value of this method and of the fact that it is no longer an experiment, but conceded by all intelligent men to be a valuable adjunct to our methods of storing food for stock, there are still many unsettled or half-settled questions relating to it that demand attention. Nothing succeeds like success, and since the silo has come into favor, it has found many ready writers to urge its adoption.

I have endeavored to be temperate and conservative in my claims for the silo, and not to jump at my conclusions; for I fully believe that the half digested statements of many enthusiasts, without practical knowedge, have been as much of a hindrance to the introduction of the silo as the persistent opposition of some scientists, who have ignored practical results because they did not conform to their preconceived theories.

In the following pages I have aimed to give such suggestions about silos, the making and feeding of ensilage, as our experience has shown are calculated to give the best results.

Believing the testimony of practical farmers, in various parts of the State, who had silos would be of great value in this connection, I addressed a letter, with a schedule of questions, to several of them, with a request for replies based on their experience. A large amount of valuable information is embodied in their answers, published herewith, which, without exception, are decidedly favorable to this system.

SILOS—LOCATION, CONSTRUCTION AND MATERIAL.

As a matter of convenience and economy in handling the ensilage, the silo should be as near the feeding room or stable as possible, and on the same level. It may often be economically located in the bay of the barn, or in some adjacent building. The carting of the ensilage from the silo to other buildings is not only expensive, but there is more or less of waste from the exposure.

In the early history of silos it was thought that only stone, brick or concrete could be used in their construction, and that deep excavations or pits were preferable to having the structure largely above ground. More extended experience has demonstrated the fact that these more expensive materials are not necessary, but that silos built of lumber preserve the ensilage as well, if not better, and no difficulty is experienced in keeping the ensilage when the silo is entirely above ground.

I do not wish to be understood as objecting to the use of any of these materials. All of them have been used in the construction of silos and have proved satisfactory, so far as keeping the ensilage was concerned. Some have experienced trouble with the stone walls on account of their having proved conductors of the frost. We have never had much trouble in that particular, but the stone or brick silo is too expensive. The farmer is not apt to think of it as a permanent investment, and if he can build a silo with lumber, which is equally as good or better while it lasts, for less than half the expense of the stone or brick, he is quite likely to decide upon that material.

It will be remembered that the first silos in this country were excavations made in impervious soils. Mr. Francis Morris, of Maryland, made ensilage of corn in such excavations as early as 1876.

At the recent ensilage convention held in Cleveland a vote was taken on building silos; twelve voted for double boarding, with lath and plaster; three for double boarding, with tarred paper; and seven for only one thickness of matched narrow lumber on the inside of studding.

Great care should be taken to have the walls of the silo smooth and vertical, so that the ensilage shall settle evenly.

SIZE OF THE SILO.

To determine the size of the silo, estimate as a daily ration for each animal to be fed about 6 per cent of its live weight. This amount of good corn ensilage with a few pounds of wheat bran, oats, oil meal, or clover hay will keep animals in fine growing condition, and also will be found a good milk ration. Taking this estimate, to illustrate: Ten cows, weighing 1,000 pounds each, will consume 600 pounds of ensilage daily, or 18,000 pounds per month, or 108,000 pounds in six months.

We have found by actual weighing that a cubic foot of ensilage, two feet from the surface of the silo, under moderate pressure, weighs 36 pounds; eight feet below, 48 pounds; ten feet below, 50 pounds. It is safe to estimate about 40 pounds as the average weight of a cubic foot.

We must also make calculation for the settling, in our estimates. If well packed this will be found one-sixth to one-eighth of the depth of the ensilage; 108,000 pounds would require 2,700 cubic feet of space; add one-sixth for settling, and we have 3,150 cubic feet. A silo 22 feet deep, 10 feet wide and 14 feet long will give this capacity.

How can the same storage capacity be secured so cheaply as in this small silo? And when we add that this 54 tons of ensilage is sufficient, with a grain ration, to keep the 10 cows six months, and may be grown from three acres of good land, it opens up and emphasizes the possibilities of the silo as one of the main reliances of the stock man in these times of low prices.

It is better to build too large, than too small; have good height, avoid the deep silos or caverns from which the ensilage must be raised by machinery.

With a large silo I should prefer a partition, it is often more convenient in filling, especially if different crops are to be grown for this purpose. In feeding, so large a surface is not exposed, and consequently there is less liability of injury and waste.

Our first silo was built of stone in the basement floor of a barn; the new one, erected in 1887, of lumber and tarred paper. The following brief description will, it is hoped, give a clear idea of its plan and construction. The cost of a silo built in this way need not exceed from $1.50 to $2.50 per ton of its capacity. It is well to get as much depth as we can consistently, as the roof is the most expensive part of the building, and in feeding a less surface is exposed.

While we have always cut off a section of the contents near the door of the silo, as we began feeding the ensilage, for convenience (as one would cut out a section of a hay mow), and without loss, I am inclined to the opinion that it may be preferable to begin feeding from the top and take from the entire surface, if it can be done without too great an outlay of labor.

THE COLLEGE SILO.

The dimensions of the last silo built at the College are 18x30x22, with a partition in the center, making two silos each 15x18 outside measurement, and with a total capacity of nearly 200 tons. The silo is located on the north side of our cattle barn, which has a basement stable. We excavated some six feet to have the silo floor on the same level as the stable floor. The excavation is walled up to the surface with stone laid in ordinary mortar—a good 18 inch wall. Doors open from each silo into the feeding room, adjacent to the stable and on the same level. On this wall sills made of plank are bolted, and joists 2x12 and 16 feet long were used for studding and placed one foot apart. On the outside ordinary stock boards, battened and painted with two coats, made the finish. On the inside the studding was first covered with shipping culls, put on horizontally. On these a layer of tarred paper, then a second covering of boards was put on perpendicularly. This was lathed and plastered with water lime cement.

The floor is just as left when the excavation was finished. A good shingle roof, with a window and outside door in each silo—the latter for putting in and taking out the materials for weighting—completes the building.

The ensilage would have kept just as well without the cement coat. We put that on to preserve the boards; kept constantly wet, they will soon decay where the ensilage is placed next to them. As a hay barn this silo would hold twenty tons; but it has a capacity equivalent in feeding value to sixty-five tons of hay, estimating three tons of ensilage equal to one ton of good hay, which we have found in actual feeding a fair comparison.

The sides of the silo are well tied by strong iron rods that run from side to side. I lay much stress upon the use of 2x12 studding placed one foot apart. They not only add to the strength and lessen the danger from the lateral pressure, but also leave a twelve inch air space which affords more protection from the frost. The difference in the cost will not warrant the risk incurred by the use of light lumber in the construction of the silo.

CROPS FOR ENSILAGE.

It is claimed that any crop suitable for feeding in the green state will make good ensilage.

That a great variety of plants have been used with success for this purpose is well known.

Pease, oats, millet, rye, clover, sorghum, and many other forage plants have strong advocates of their merits for ensilage.

Indian corn is, however, the great ensilage crop of America. Clover is, by many good authorities, ranked second.

Corn is, perhaps, the surest of our forage crops, and, considering all the country, gives a greater yield than any other. The question is often asked, "What variety of corn is best for ensilage?" Some advocate the use of sweet corn; some a variety of ordinary field corn, and others the southern corn. Sweet corn does not seem to be as valuable for ensilage as the dent varieties. It yields less and there will be more acid in the ensilage, so that it is not usually as palatable. When the opinion prevailed that the leaf and stalk were the more desirable parts and the grain of little consequence, southern varieties were largely cultivated. The seed was much of it sown broadcast or very thickly in drills.

On both of these points there has been a change of opinion, one the natural outgrowth of the other.

It is now generally believed that the more mature the grain while the stalk remains green, the better the ensilage will be. So that early maturing varieties are now considered most valuable. A test of several varieties recommended for ensilage will be found in this bulletin. To obtain mature corn there must be more room for each plant, so thinner seeding is now practiced.

WHEN AND HOW TO PLANT.

We sow with the Vandiver corn planter, in drills 3 feet 9 inches apart, using about 12 quarts of seed to the acre, and cultivate thoroughly during the growing season.

While very large yields per acre of ensilage corn are frequently reported, an experience of some years leads me to infer that these large yields are based on estimates, rather than on actual weighings. I am of the opinion that 20 tons to the acre is an exceptionally large yield. We have had some very good crops, but have never exceeded that weight per acre. From the 10th to the 20th of May is the best time for planting in this State.

WHEN TO CUT THE CORN.

For some years corn was put into the silo when very green. We now know that to make ensilage of greatest value, the corn should be more mature. The practice among those most successful with the silo, is to cut when the grain is beginning to glaze.

Prof. Goessmann, of the Massachusetts Experiment Station, who has given this subject much attention from a chemical standpoint, says, in the report for 1887: "It was found that the same variety of corn, raised under fairly corresponding circumstances, as far as the general character of the soil and the mode of cultivation are concerned, contained in one hundred weight parts, at the time of the first appearance of the tassel, from twelve to fifteen weight parts of dry vegetable matter, and from eighty-five to eighty-eight parts of water, while at the time of the beginning of the glazing of the kernels the former was noticed to vary from twenty-three to twenty-eight weight parts, and the water from seventy-seven to seventy-two."

Speaking of changes in plant composition, he says: "As long as the vital energy of an annual plant is still essentially spent in the increase of its size, as a rule but a comparatively small amount of valuable organic compounds, as starch, sugar, etc., accumulate within its cellular tissue. The comparative feeding value of the same kind of fodder plants, or any particular part of such plants, is not to be measured by its size but by the quantity of valuable organic constituents stored up in its cellular system."

He draws these conclusions: "The amount of vegetable matter in a given weight of green fodder corn, cut at the beginning of the glazing of the kernels, is known to be not only nearly twice as large, as compared with that contained in an equal weight of green fodder corn when just showing the tassel, but it is also known to be, pound for pound, more nutritious, for it contains more starch, more sugar, more of valuable nitrogenous matter, etc." We have put corn into the silo when the stalks were partially dry and sometimes after they had been frosted, and while we cannot doubt that there was some loss in nutrition, the ensilage was fairly good, and I am confident the corn so injured could in no other way have been as cheaply and economically stored for winter use.

The following tables are inserted here for reference, the first to show the difference in the nutritive value of ensilage made of corn cut at different stages of growth.

The analyses were made by Dr. C. A. Goessmann, Director of the Massachusetts Experiment Station.

The second, by Dr. E. H. Jenkins, of the Connecticut Experiment Station, gives comparative values of ensilage and various other fodders:

Variety.	Source of Analysis.	Moisture.	Dry matter.	Analysis of Dry Matter, 100 Parts.					Per Cent of Digestibility.				Nutritive ratio.
				Crude ash.	Crude cellulose.	Crude fat.	Crude protein nitrogenous matter.	Non-nitrogenous extract matter.	Crude cellulose.	Crude fat.	Crude protein.	Non-nitrogenous extract matter.	
Corn ensilage	Board of Agriculture, '80	80.70	19.30	9.17	33.32	3.21	8.08	46.22	72	75	73	67	1:10.34
Ensilage of corn in tassel	*Report II	86.88	13.12	6.89	33.66	3.88	12.58	42.99	72	75	73	67	1:6.57
Ensilage of cut corn	Report III	81.88	18.12	5.07	26.23	3.49	7.83	57.38	72	75	73	67	1:11.8
Ensilage of whole corn	Report III	83.18	16.82	4.23	29.44	3.69	9.03	53.61	72	75	73	67	1:9.71
Corn ensilage	Report IV	77.48	22.52	4.19	19.08	3.49	7.82	65.42	72	75	73	67	1:11.3

*Reports referred to above are those of Mass. This table is taken from the Mass. Ag'l Report for 1887.

Report of Connecticut Experiment Station, 1888. Analyses by Dr. E. H. Jenkins. Composition of American Feeding Stuffs.

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Green Fodder:																	
Maize fodder	75	7.1	48.5	21.26	.5	3.0	1.80	.1	.9	.45	3.2	22.1	12.94	1.9	11.4	4.99	1.08
Maize fodder, ensilaged	59	13.0	35.6	19.72	.7	2.8	1.52	.2	1.8	.70	5.1	22.2	10.49	3.0	10.0	5.70	1.31
Sorghum	7	13.6	28.4	21.66	.9	1.4	1.10	.2	.5	.31	5.3	27.0	13.08	4.7	8.5	6.25	.87
Sorghum, ensilaged	5	22.0	28.1	24.17	.6	.9	.75	.1	.4	.28	13.8	19.0	15.82	5.9	6.8	6.28	1.04
Rye fodder	6	21.9	25.3	24.72	2.3	3.0	2.61	.2	.7	.56	4.9	12.4	6.94	4.9	14.9	12.73	1.88
Rye fodder, ensilaged	1	......	......	19.25	......	......	2.42	......	......	.27	......	......	9.18	......	......	5.76	1.62
Oat fodder	2	21.4	28.8	25.10	1.5	2.0	1.77	.4	.7	.57	10.8	14.6	12.70	7.1	9.5	8.27	1.79
Clover	1	......	......	26.67	......	......	4.09	......	......	.69	......	......	11.61	......	......	8.12	2.16
Clover, ensilaged	3	21.5	27.4	23.73	3.0	3.8	3.34	.9	1.1	1.02	8.1	11.4	10.21	5.1	8.6	6.66	2.50
Lucerne or Alfalfa	6	18.0	28.5	22.83	3.6	4.9	4.09	.7	1.0	.83	7.9	11.8	9.60	4.9	8.7	6.26	2.05
Serradella	3	15.4	19.9	18.23	2.3	2.7	2.49	.4	.4	.41	6.4	7.0	6.80	4.0	7.7	6.42	2.11
Cow-pea vines, green and succulent	5	13.9	27.2	19.93	1.7	3.3	2.30	.2	.6	.43	5.3	12.9	9.27	2.9	15.3	6.31	1.62
Beet leaves	1	......	......	11.16	......	......	2.74	......	......	.60	......	......	2.49	......	......	2.50	2.83
Carrot leaves	1	......	......	16.70	......	......	4.26	......	......	.86	......	......	5.99	......	......	2.25	3.34
Cabbage ensilage	1	......	......	12.39	......	......	1.19	......	......	.93	......	......	4.52	......	......	1.59	4.16
Hay and dry coarse fodder:																	
Clover hay	33	78.2	93.9	88.62	8.9	20.8	12.55	1.5	4.3	2.44	35.0	49.0	40.55	15.6	35.7	26.85	6.23
Hay containing much clover	10	85.5	89.8	86.68	6.3	14.4	10.33	1.5	3.1	2.52	31.8	45.2	40.46	19.7	35.1	28.07	5.30
White clover hay	2	91.4	92.9	92.12	14.1	20.0	17.03	2.1	5.8	3.95	38.2	40.6	39.38	20.3	27.3	23.75	8.00
Alsike clover hay	5	91.4	94.7	92.38	11.4	16.1	13.53	1.6	4.2	2.41	36.5	43.5	40.91	21.0	29.5	27.68	7.85
Lucerne hay	4	91.6	94.3	93.05	10.2	18.6	15.33	1.4	2.4	1.89	35.4	47.3	39.66	26.2	33.0	29.20	6.97
Serradella hay	3	88.3	93.8	90.80	13.9	16.6	15.24	2.2	2.7	2.74	40.5	46.0	43.95	19.4	23.0	21.64	7.23
Timothy hay (*Phleum pratense*)	55	84.5	92.9	89.79	4.2	9.6	6.15	1.0	3.4	2.12	39.2	58.5	46.98	22.7	38.5	30.35	4.19

Report of Conn. Experiment Station, 1888—Continued. Analyses by Dr. E. H. Jenkins Composition of American Feeding Stuffs.

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Hay and dry coarse fodder—Continued:																	
Red top hay (*Agrostis vulgaris*)	2	90.2	93.2	91.68	7.3	7.8	7.50	1.5	2.0	1.70	46.5	46.9	46.72	27.5	31.8	29.62	6.14
Timothy and Red top	10	85.7	91.8	87.64	4.8	9.0	6.52	1.5	2.7	2.00	38.5	48.9	44.15	24.7	38.4	30.17	4.80
Orchard grass hay (*Dactylis glomerata*)	5	88.2	93.5	91.68	3.6	8.2	6.69	1.4	2.4	1.98	33.5	48.6	44.04	29.7	38.3	44.04	5.72
Hungarian grass hay	13	91.0	95.2	92.85	5.0	12.3	7.22	1.5	3.5	2.14	44.4	53.0	49.41	23.6	31.3	28.25	5.83
Barley hay (seed in milk)	1	....	....	89.75	....	....	9.21	......	......	2.47	......	......	47.49	......	......	26.14	4.44
Oat hay	3	86.3	91.3	89.32	7.8	9.9	8.53	2.1	3.1	2.52	36.2	48.0	41.93	25.1	33.6	29.92	6.42
High meadow hay	2	88.7	89.4	89.02	6.8	8.3	7.57	2.0	2.5	2.25	46.9	47.5	47.19	24.3	25.2	25.78	6.23
Hay from mixed meadow grasses	11	79.7	87.0	84.01	4.8	9.2	6.38	1.4	2.7	2.09	34.4	47.3	41.05	22.9	35.9	29.90	4.62
Low meadow hay	10	85.5	93.6	89.50	4.6	10.4	7.70	.7	3.6	2.20	39.8	55.2	43.60	21.4	40.0	30.20	5.80
Hay from salt marsh grasses	13	81.4	92.8	89.89	4.0	7.8	5.69	1.6	3.1	2.31	34.1	54.3	44.10	25.1	37.9	30 51	7.28
Baled hay "extra fine"	1	....	....	84.05	....	....	6.20	......	......	2.19	......	......	45.13	......	......	26.60	3.93
Maize fodder, field cured	7	60.6	77.1	69.40	3.8	6.8	5.14	.6	2.0	1.40	30.5	47.8	39.08	14.4	24.7	19.61	4.17
Maize stover, field cured	13	51.3	84.6	75.56	3.0	8.3	5.29	1.1	2.2	1.48	26.4	46.2	40.09	17.7	29.5	24.17	4.53
Buckwheat straw	3	89.6	91 0	90.09	3.3	7.8	5.15	.7	1.7	1.26	32.1	38.9	35.16	37.2	46.8	42.98	5.54
Oat straw	12	87.5	93.5	91.26	2.3	6.9	3.82	1.0	3.2	2.22	26.4	51.4	38.89	29.5	56.0	41.52	4.81
Rye straw	8	87.5	93.7	92 24	2.2	6.9	3.46	1.0	2.7	1.40	35.7	52.9	38.35	34.2	43.3	45.25	3.78
Wheat straw	6	82.1	93.5	91.22	2.9	5.0	3.45	.8	1.8	1.29	31.0	50.6	37.33	34.3	42.7	44.99	4.16
Cow-pea vines	6	86.0	90.7	85.95	13.6	19.8	15.68	1.1	4.1	2.87	34.9	46.4	42.17	17.2	23.7	19.80	8.41

FILLING THE SILO.

Various methods of cutting corn and drawing it have been suggested. No one is probably always the best. Some use a reaper, cutting one row at a time. We have cut our corn by hand, and have found that by driving the wagon close along the row and cutting not more than two rows at a time, so as to avoid carrying any distance and having the men who are cutting place each armful directly on the wagon, never laying it on the ground to require a second handling, the most satisfactory.

The stalks, if proper care is taken in loading, are all laid straight and in the best possible shape for going to the feeder, which enables him to feed with more facility than would be possible with them tangled more or less, as they will unavoidably be when cut with a reaper or thrown in bundles on the ground.

Some have advocated cutting the corn and allowing it to wilt for a day or two before putting in the silo, but I do not think this practice is to be commended. It increases the labor, and if the corn is properly matured, the sooner it is placed in the silo after cutting the better.

Some writers lay great stress upon having the corn dry when it goes into the silo. That rain-water upon the corn injures it is denied by all experienced silo men. Some say that their best ensilage is that which went into the silo when quite wet. It is no unusual thing to have a load or two caught in a shower, and no one need fear any injury resulting from putting the corn in wet. If corn fodder was over ripe, so that the stalks were quite dry or had been frosted, I think the ensilage made from such fodder would be improved by wetting it quite thoroughly when put into the silo.

We use the Belle City feed cutter and carrier made at Racine, Wis.; our power is a ten-horse engine. The tread, circular and geared powers, sold for from $50 to $100, will be found satisfactory for cutting ensilage, and can also be utilized in much other work where power is demanded on the farm.

We have always kept a man in the silo (sometimes two or three when student help has been plenty) to keep the ensilage evenly leveled and packed solidly. I am aware that some writers seem to think this careful, solid packing unnecessary; but I am convinced, after years of experience, that when this has been attended to most carefully, everything else being equal, we have had the best ensilage. It is well to throw the cool ensilage from the corners and about the walls of silo into the center and replace it with that which is warmest, thus preserving an even temperature.

I should always advise cutting the corn. Some have practiced putting it in the silo without, but the long stalks do not pack as closely as when cut in half or three-quarter inch lengths, and there is more danger of injury to the ensilage, while it is much more troublesome to take the long stalks from the silo. I think it will be rare to find anyone who has practiced both methods, who will favor filling with the uncut stalks.

Clover may be placed in the silo without cutting.

SLOW OR RAPID FILLING.

During the first years of ensilage making, it was urged that the silo should be filled as rapidly as possible. More experience has led to a change of opinion on this point, and the theory has been advanced that if the silo was filled slowly and its contents allowed to heat up from 120° to 130° Fahrenheit, the bacteria or germs that cause fermentation would be destroyed and we should have what is termed sweet ensilage, it being claimed that the rapid filling tended to produce more acid, resulting in sour ensilage. This theory of producing sweet ensilage by slow filling has been quite generally accepted and practiced for two or three years past.

I am of the opinion, however, that positive evidence to sustain this theory is almost if not entirely wanting. Enough careful work has not been done to demonstrate it beyond question. A large number of careful and experienced men claim that rapid filling makes good enough ensilage, and is much more economical so far as labor is concerned.

At an institute in Pennsylvania last winter two specimens of ensilage were brought in for inspection. One sample was much sweeter and of better quality than the other. This sample, it was afterward learned, had been made in a silo filled rapidly, while the other was the result of slow filling and heating to the degree of temperature claimed to kill the bacteria. The corn was alike and the conditions the same so far as I could learn, except in this one particular of the slow and rapid filling.

May it not be that the reason for our having better ensilage in recent years is to be attributed to the fact that we have been putting in our corn when more nearly matured than formerly? Certainly there should be some careful experiments made to determine whether the theory is correct or not.

On this point Prof. H. E. Alvord, President of the Maryland Agricultural College, whose long experience and varied experiments with ensilage make him one of our best authorities, says: "From its first introduction the chief fault found with ensilage has been the acid character of the material at the time it is fed to animals. This acidity results from fermentation in the silo, caused by living organisms, known as bacteria. Enthusiastic friends of this process of preserving forage claimed, a few years ago, that they had discovered a method of making sweet ensilage.

"The theory upon which this method is based is that the bacteria of the ensilage fermentation are destroyed and the fermentation thus arrested by a certain degree of temperature, placed variously at 120° to 140° F. The little creatures are induced, as it were, by favorable conditions, to work themselves into such a state of excitement as to die of apoplexy from their own fervent heat. It is a very pretty theory, or was, as long as it lasted, but that was not long. As well try to fan a fire to such intensity that it would extinguish itself and without injury to the fuel. Careful students soon discovered that the bacteria of the silo were particularly happy and active at the very temperatures which it was claimed would destroy them. Temperatures 120° to 160° F. are most favorable to their development and activity, and it requires at least 185° to destroy them, while fermenting ensilage does not often exceed 140°, and no authentic record of 150° F. can be found. How men could so deceive themselves—and some of scientific reputation have been among them—it is hard to understand; but the evidence is conclusive that they were wrong. I have never yet been so fortunate as to see any ensilage which I could call 'sweet.' Of course, the material differs greatly in the degree of its apparent acidity, and as comparative terms, sour and sweet may be convenient as applied to ensilage, although deceptive. I see no evidence that any relation exists between the method of filling the silo—the slow process or the quick process—and the acidity of the product. On the whole, I prefer the straight ahead way, no undue haste, but pushing the job of harvesting and filling to completion without unnecessary delay. It is most economical of labor, especially if the task is a large one, and gives ensilage of full as good a quality. Yet, if circumstances make slower work desirable, or if an accidental detention occurs, there need be no fear of serious loss."

Prof. Henry, of Wisconsin says: "In regard to making the so-called sweet ensilage, the main point appears to be to have the corn well ripened, ready for early cutting and shocking. Corn ripened so that the grain begins to dent will make sweet ensilage, even if the silo is filled in a single day."

THE WEIGHTING OF THE ENSILAGE.

In the early history of the silo heavy weighting of the ensilage was used as an essential detail to secure a good product. More extended experience has modified our views on this point. Now many of our experienced silo men think that no weight is needed, and that covering with a foot of cut straw or hay is all that is necessary.

I have no doubt that a crust from six to twelve inches deep will be formed on the surface of the ensilage that will usually protect the product below without any weight or covering. The question is one of economy merely as to the saving of the ensilage. It would often be as expensive to draw and cut the straw or hay as it would be to put on a moderate weight if materials are at hand. The labor and expense of weighting I think has been overestimated by many writers on this point.

The extra outlay required to weight moderately is too trifling to warrant our taking the chance of a failure because of neglect in this particular.

FEEDING OF ENSILAGE.

In the fall of 1881 we filled our silo for the first time, and from that date to this, with the exception of a single year, we have fed ensilage more or less every winter. Every year's experience only confirms and strengthens our faith in its value as a most excellent and cheap part ration for stock, so that our verdict, after seven years of fair and practical trial, is decidedly in its favor. I would not know how to get our stock through the winter without ensilage. It is especially adapted to cattle and sheep, and is being fed extensively in some large horse breeding establishments. Mr. M. W. Dunham, of Du Page, Illinois, the noted Percheron importer and breeder, has, I learn, fed ensilage largely this season. Swine and poultry are also reported as eating it readily and with good results.

During the first excitement over ensilage it was claimed that it was a whole ration. It is now demonstrated that to secure the best results clover hay, oats, wheat bran, oil meal, or other nitrogenous foods should always be fed in connection with corn ensilage.

The same is true of dried corn fodder. The corn plant, green or dry, stalk or grain, is not a well balanced ration, having too large a per cent of carb-hydrates or fat formers.

It will always pay to combine to a limited extent more nitrogenous foods with our corn rations. The health and thrift of our animals will be secured and they will give more liberal returns at the pail or in meat production when fed in this manner.

Ensilage is excellent food for dairy cows, producing milk of the best quality. The evidence of such men as Mr. Hiram Smith and Prof. Henry of Wisconsin, and Mr. E. A. Powell of Syracuse, New York, and a host of others, whose names might be mentioned, on the value of ensilage for milk production, ought to satisfy any reasonable man of its merits.

Good ensilage, if fed judiciously, will produce good milk, that will, I believe, prove satisfactory for any use.

Prof. Alvord found in a test made at Houghton farm, that a greater per cent of the fats of the milk were converted into butter when the cows were fed grain and corn ensilage than when fed hay and grain.

Prof. F. W. A. Woll, of the Wisconsin Experiment Station, found that 12.60 per cent more of the fat was churned out from the mixed milk of two cows when the cows were fed on ensilage than when they received corn fodder.

The story, started some years ago, that manufacturers of condensed milk would not buy the milk from cows that had been fed ensilage, has been repeated time and time again by the opponents of this method of preserving fodder as evidence of its lack of value. It is now stated, on good authority, that in this case the injury was caused by the polluted water which the cows were compelled to drink, and that the ensilage had nothing to do with it whatever.

The lie has gone many leagues, in this case, while truth was getting on her boots.

ENSILAGE A SUBSTITUTE FOR ROOTS.

As early as 1882, I took the position that ensilage would be a cheap substitute for roots, furnishing the succulent fodder so needful for our stock during the long period of winter feeding.

I go further today and affirm that good corn ensilage is, in my opinion, more than a substitute for roots. It has a much higher value. In confirmation of this statement I refer to our experience last winter. We grew some hundreds of bushels of roots, which were put in the root cellar the last of October. The cellar was nearly full, and, as the weather continued so mild, I feared there was some danger of their rotting. On account of this I directed the herdsman to defer opening the silo until the first of January and to commence feeding the roots, so that we might open up ways through the pile and secure more ventilation and so obviate the risk of decay.

Roots were fed until January first, when our silo was opened and we began to feed ensilage. It is of first quality this year, much of the corn was fairly well eared and cut in the roasting stage or a little past. I do not think a casual observer could have failed to notice how rapidly our cattle improved in flesh, in thrift, as evidenced by the hair and general appearance, when we fed the ensilage in place of the dry corn fodder and roots which they had received through December. I should say the grain ration was lighter with the ensilage than with the roots and dry fodder. This is only observation, it may be said; but reference to the reports of careful experiments made here in recent years and published in former bulletins, will prove by exact figures the correctness of this position.

SILOS IN THE UNITED STATES.

The number of farmers in all sections of our country who are adopting this system is rapidly increasing. Statistics are not very accurate as to the number of silos, but it is estimated that in Wisconsin there are not less than 1,500, Massachusetts almost as many, Vermont between 200 and 300, New York quite a large number. I think in Michigan there cannot be less than between 100 and 200, and many of these were erected last season. Prof. Robertson, of Ontario, reports that a large number will be built in that province the coming season.

ENSILAGE IN ENGLAND.

The English Parliament appointed a committee to investigate and report upon this method of preserving fodder, as likely to be of great importance to agricultural interests. The committee, composed of some of the best known men in the kingdom, after taking a large amount of evidence from those who had built silos and fed ensilage, and after the most thorough examination of the subject, made a favorable report. They report that "all the evidence seems to show that a nourishing, useful food for animals can be preserved by this process." They further report "that the testimony of the dairy farmers *does not justify* the assertion that dairy products are injuriously affected by ensilage, but that on the contrary it distinctly improves the yield of milk and cream and the quality of the butter; the silos in Great Britain have doubled in number in the last twelve months; and that the evidence warrants the extension and development of the system as a valuable auxiliary to the farm."

In 1886, 1,605 silos were reported in England, in 1887, 2,694—nearly doubling in a single year. Exact figures are not at hand for 1888, but more silos have been built than in any previous year. Even in "Merry Old England," the birthplace and home of root culture for centuries, ensilage seems to be taking the place of roots as a stock food. As evidence of this fact I quote the following from a writer in a recent number of "The Agricultural Gazette," published in London:

"I find I can get about the same weight per acre tares ensilage as I used to grow of Swede turnips, and the latter required one acre of hay in addition to one acre of turnips to feed the same amount of stock as I can now feed off the one acre of tares alone—that is, one acre tares ensilage goes as far as one acre Swede turnips and one acre meadow grass hay put together. Therefore I think one of the great features of ensilage will prove to be that it will entirely supersede the growth of turnips. It is cheaper to grow than turnips, is as good and cheaper as a cleaning crop, and saves the one acre of hay in addition. On strong land, where roots cannot be grown, of course there is no question. The average turnip crop throughout the kingdom is, I believe, 12 to 13 tons per acre; the average of tares would be little, if any less; those with best turnip land may grow 20 tons per acre and more, but such land will also grow exceptional crops of tares—and it is palpable that though such land specially favorable for turnips may grow more of them than of tares, it will not be sufficiently greater to counterbalance the extra cost of cultivating of the whole of the requisite acre of hay."

The cost of the silo need not deter any one from adopting the plan. I am confident you cannot secure storage for an equivalent amount of forage in any way at so little expense as you can in the silo. It costs almost if not quite as much to cut an acre of dried corn fodder as an acre of green, save the one item of hauling—you have the expense of hauling, binding stalks and setting up in shocks. The corn must be cribbed, be hauled to mill, crushed to cob meal or shelled and ground, hauled home; all items that count and add materially to the cost of feed. When you put your corn in the silo the one operation finishes it, and all you have to do is to place it all prepared before your animals, who look their gratitude for such palatable rations. You will not be charged with want of sense or fanaticism if you build a silo.

I want to controvert the often expressed idea that the small farmer cannot afford the silo, I believe if the farmer with few acres looks at this question rightly, he will find the silo an essential adjunct to his farm dependencies quite as much, aye more, than the large land owner. The small farmer with limited area of land is necessitated to crop more continuously than his neighbor with a much larger acreage. He needs in every possible way to secure the fertilizing material that shall replace the drains that this closer cropping is making on his fields. How can he do it so cheaply, so surely, as by growing large crops of ensilage corn that will give him the main fodder necessary to enable him to feed for the market or the dairy through the winter much more stock than his acres will carry in the summer?

VIEWS OF PROMINENT FARMERS OF MICHIGAN ON ENSILAGE.

The following schedule of questions is the one referred to on a former page of this bulletin, and the replies from prominent farmers in different sections of the State will be read with interest and profit, especially by persons in their vicinity who contemplate building a silo:

QUESTIONS RELATIVE TO SILO AND ENSILAGE.

1. When did you build your silo?
2. How is it constructed?
3. What crops have you ensilaged?
4. What variety of corn have you found most satisfactory?
5. Do you plant in hills or drills?
6. How much seed to the acre do you use?
7. At what stage of growth do you cut?
8. What is the average yield per acre?
9. Is this yield estimated or weighed?
10. Have you ever put corn in the silo uncut?
11. Do you fill the silo rapidly or slowly, and why?
12. Do you pack the ensilage as closely as possible during the filling?
13. What do you use for covering?
14. Do you advise moderate weighting?
15. What does your ensilage cost per ton or per acre?
16. How many months after filling the silo was it opened?
17. What was the condition of the ensilage?
18. Did it change after opening, if so, how?
19. Do you feed ensilage alone, or in combination with dried fodder and grain?

20. What is your opinion of ensilage for milk production?

21. In your opinion, is the quality of milk injuriously affected by feeding ensilage?

22. Have you had any experience in feeding ensilage to sheep, swine or horses?

23. In your opinion, can storage be secured in any other way, for an equivalent amount of fodder, so cheaply as in the silo?

24. With your experience, do you consider this method of preserving fodder economical and satisfactory? Would you advise your brother farmers to build silos?

The numbers used for the replies correspond to those of the questions.

Some of the matter used was not received in reply to the inquiries noted, but bears an earlier date, hence the difference in arrangement.

I. H. BUTTERFIELD, LAPEER.

1. In 1886. Have two compartments in bay in barn.

2. Of boards and tarred paper. In one a double coat of paper, with an air space; the other, but one coat of paper and one thickness of boards inside the studs, set up against the girts in bay. Do not see any difference in keeping ensilage between them.

3. Corn mostly, filled once with uncut clover; did not like it, although cattle ate nearly all of it.

4. Have used several kinds of corn, common yellow, white, dent and Southern ensilage; prefer common dent, planted in rows 3½ feet apart, and hills 18 inches apart, or in drills.

6. Using about twelve quarts of seed per acre.

7. At full growth.

8. Estimate, ten tons.

9. ———

10. Put in ten or twelve tons in bottom of one silo in 1888, and filled with cut corn. The uncut came out in good condition, but is not as convenient to feed as that cut; think it a good method for one who wanted but a small silo that would not pay for the expense of preparing for cutting.

11. Slowly, partly because I thought it the best method, and partly from convenience; would fill rapidly, if more convenient.

12. Have packed it well while filling.

13. Tarred paper and boards, think one foot of straw or marsh hay (cut) just as good.

14. Ensilage has kept good with very little weight.

15. Have not filled in a manner to keep any account of expense; would prefer handling the corn in this manner to that of cutting and curing in shock, hauling in and cutting when dry so far as expense alone.

16. About two months.

17. Generally good; occasionally some loss in corners.

18. Think not; practice now uncovering top and taking from surface daily.

Under date of February 22, 1887, Mr. Butterfield says: "I have fed it to all my cattle, one feed per day, making ond-third of the bulk of fodder I feed them. Previous to this they had a feed of hay, which the ensilage took the place of, and to all appearance the ensilage fully supplied the place of the hay. I made no tests to afford any positive conclusions in regard to its effect on quantity or quality of milk, but my cows held to their milk well during the *very* cold weather that followed the first of January, and the same cows are doing better in quantity than they did on the same grain and all dry fodder, fed one year ago."

WM. A. BLAKE, GALESBURG, MICH.

1. I built a silo in 1888, in two compartments, each 16 feet square inside measurement, and 21 feet high.

2. It was built in a barn by placing studding inside of the girts and between the cross sill and beams, with two thicknesses of common barn boards, with tarred paper between on the inside of studding.

3. I filled it with corn grown in hills as field corn is ordinarily grown, not intending at the time of planting to put it in the silo.

4–5–6. I think I shall use the same kind of seed for ensilage that I do for the regular field crop, planting in drills three and a half feet apart, and twenty grains to the rod as near as may be.

7. I cut when the corn is as mature as it can be while the fodder remains green.

8. The actual weight of the field corn I placed in the silo was about six and a half tons per acre. Owing to dry weather I think it was about one-half of an average crop.

10. One of my neighbors filled a silo with whole cornstalks bound in bundles. It was not a fair test, however, as a stone wall projected inside of wood lining nearly a foot, and a beam crossed it at the top of the wall eight feet up from the bottom, which prevented the contents from settling uniformly, and the result was a burned, blackened mass, which was quite worthless as animal food.

11. I filled at the rate of 12 tons per day, first filling one, then the other, but shall hereafter alternate between the two, changing from one to the other each day, and shall allow the fodder put in the first day to become heated to quite a high degree before proceeding, and then fill as fast as I can.

12. When filling I kept a man in the silo spreading and treading the fodder, doing most of the packing around the outside.

13. 14. I covered with two thicknesses of boards with tarred paper between and a light covering of earth to fill the crevices and to make sure that the covering shall settle with the fodder, which is all the weighting I deem necessary.

16. 17. I opened the silo about three months after it was filled. Immediately under the covering, to the depth of from four to eight inches, the ensilage was partially spoiled, but all below that was well preserved.

18. I could not discover that it underwent any material change from exposure to the air after being opened.

19. I feed ensilage once a day and dry feed of some kind to complete the day's ration.

20. 21. I feed milch cows one full feed of it once a day, and I think it materially increases the quantity of milk, and the quality, if not improved, is not impaired.

22. I feed ensilage to cattle, sheep and horses with apparent good results. I have not fed it to hogs to any extent.

23. I know of no other way that so great an amount of fodder can be stored in a given space, and preserved for animal food, as by placing it in a silo and the feed is eaten with more avidity and quite satisfactory results to both animal and owner.

24. I think the ensilage system is now so well established that the silo need no longer be looked upon as an experiment, and in connection with live stock growing it cannot with good economy be dispensed with.

SAMUEL L. FULLER, GRAND RAPIDS, MICH.

1. Three years since—summer of 1887.

2. Of grout—32x70x16 ft. deep—built from the surface, with cement bottom on the level with stable floors; walls one foot thick at bottom and nine inches at top, divided into four compartments, 16x30, inside measure; entrance by 4 ft. doors in end opposite stable. Doors continue through the silos so as to enable feeding by a car holding 30 bushels and run on a 4x4 inch tramway from silos through stable. The cross walls, 30 ft. long, with door in middle, are not heavy enough. Would build of lumber another time, it would be better.

3. Corn only, in different stages of dryness, but the best just before frost, say Sept. 10.

4. Have only used the "B and W," a large Southern corn, successfully. Am not sure it is best. It is late; only bearing roasting ears at best.

5. Have ensilaged field corn that had cured in the shock, but have not made more than a partial success of it. It has not kept as well as the green stalks. The corn was fed without knowing anything about the amount fed, and taken together, the ensilage cured corn has not been a success, not the fault of the corn, perhaps.

6. One kernel to four inches, Some stalks will bear an ear, many will not.

7. Try to escape frost.

8. Never weighed but one-eighth of an acre, that yield was at rate of 61,500 lbs. per acre, an enormous yield. Stalks many of them 15 ft. high and large in proportion.

9. Answered above.

10. Never; I cannot imagine any gain in putting it in whole, unless on a small scale.

11. Fill with teams and men enough to keep the cutting-box running, but no over work or over hours. It is more profit to push the work. The best rule is to work to most profit. The poorest ensilage we have ever had was good enough for us. Have never tried to get sweet ensilage, so called. The cattle seem delighted with all kinds.

12. The tighter it is packed, the better, particularly about the sides and corners.

13. Have covered with two-inch plank a little less in length than the width of the silo, silo 16 ft. wide, plank scant 16 ft., so that in settling the plank will not bind on the side. Cover the cracks with boards and put 18 to 24 inches in depth of seasoned wood on top. Wood is easy to handle and when removed can be drawn where you want it.

14. Have weighted cured stalks too little. Plenty of weight does no harm on any ensilage.

15. Don't ask a farmer what a thing costs. One year the entire expense

of filling and weighting the silo after the stalks were grown, was 59 cents per ton, calling 45 pounds of settled silage a cubic foot.

16. One and one-half months; don't know why it was not fed from immediately, excepting it was not needed.

17. A little on the top spoiled, perhaps an inch.

18. No; what was uncovered was fed from every day; it would begin to spoil in three days.

19. Fed it alone two weeks to horned cattle and they did well; if silage had been plenty would have kept on.

20. Nothing better but tender grass and that not much.

21. No; the dairywoman could see no difference between good fall pasture and ensilage.

22. No; have no sheep, always heard it would kill horses. I should try it on one horse if I was feeding the horse myself; I don't believe it would be injurious.

23. Storage in silo is far cheaper than any other plan. After drawing stalks from frozen ground, and in deep snow in short days in winter, we gave it up as a very expensive and "bothersome" job. Then we drew them in the fall and cut them with a power cutting-box as we needed. A large pile cut would heat and spoil. We drew them to the barn, which required pitching and loading; then pitching off, and two to put away; then two to pitch them again to the machine. This proved very expensive, and it was this expense that caused the building of the silo. Now we cut the stalks, load them on the trucks or wagon, draw to the machine, put them in the cutting-box and the carrier puts them in the middle of the silo and the job is done in the best and most economical manner.

24. Is partially answered above. I would clear a farm and fence it, build barns for housing my stock, and then build a silo of lumber. I would build it with very little, if any, excavation below my stable floor. If it could be lined inside with double flooring, sound but cheap, I should risk its being tight enough. The outside should be covered with flooring and the studding should be 2x8. If it costs too much to cover the outside the first year let it go. Closely packed ensilage won't freeze much, and taking the little that may be frozen off from the outside every day, it will effect nothing. With such a building one is prepared in the cheapest and best manner to save the winter's food.

It is marvelous the success that has attended the introduction of the silo—the few failures that are reported. It is the one step ahead in farming. It is the green feed the year round. It will double the capacity of the farm for stock raising and that means increasing the productiveness of the entire farm.

What farms need is manure. Manure means stock, ensilage means more stock. One gets a little tired preaching silos, but one should not forget how kind others have been to preach to us.

One cannot have too much ensilage, if well put up it will last indefinitely. A friend in Westchester county, N. Y., fed ensilage five years old and as he claimed perfectly preserved. I advise every farmer to build a silo, raise corn, cut it green in silo and enjoy the profit. Don't be discouraged by the cry of sauerkraut or rot, or any of the reasons that will be given you for not doing by those who have never tried it and know nothing about it by experience.

There is a difficulty that a small farmer will meet with, that is the necessity of owning a cutting-box and power to cut the stalks. In eastern States parties go about cutting stalks as they do threshing with us. There are many powers that can be utilized for driving a stalk cutter. A stalk cutter for power will probably cost about $60. If by association or otherwise this expense of cutting could be obviated the farmers' millennium would be nearer than ever before. In recommending "B and W" corn, and in answer to query No. 10, I am by no means sure that sweet corn cannot be ensilaged whole to advantage. More stalks to the acre can be cut with a side raker, can be cut earlier and leave ground ready for a fall crop. Ensilaged whole and fed whole (the cattle will do the cutting up), a grappling fork (double ice hooks) to raise the stalks with to put them in silo, would keep them straight and enable close packing. This would be worth trying. Get green feed in winter if possible; get it from corn that will yield from 10 to 30 tons per acre.

H. H. GARFIELD, ALBION, MICH.

1. August, 1888.

2. It is made in one end of the basement of the barn, the wall forming two sides, the other two a board partition, the whole lathed and plastered, the bottom cemented.

3. Corn.

4. Dent. Think it preferable to Flint, as that suckers too much; think the leaves of less value than the matured stalks.

5. Drills, three feet apart.

6. Eight to ten quarts.

7. As soon as the ears begin to glaze; think that at this stage of maturity it is much more valuable than later.

8. From four to ten tons, according to the season.

9. Estimated.

10. Have not; have seen it put in uncut, and it kept nicely, but it is more inconvenient to remove, and cannot get as much in the same space as of that which is cut.

11. Would prefer to fill it slowly as it would be less expensive.

12. I do.

13. Fine or wet straw, plank and stone.

14. In my opinion heavy weighting is preferable.

15. Never made an estimate.

16. Two and a half months.

17. To the depth of three inches it was bleached and very dry; from there on it was quite moist, and had an odor which reminded us of figs. As we worked down it grew somewhat tart.

18. No change as long as we kept the surface level.

19. Feed with grain; think the grain is more perfectly digested when fed with ensilage than when fed alone.

20. Think the quantity is somewhat increased, and the milk has more body.

21. I think it much improved.

22. Not to sheep, but for swine and horses have found it beneficial.

23. It cannot.

24. I certainly consider it both economical and satisfactory, and would advise the building of silos.

Mr. Garfield also adds: "I have had nearly thirty years' experience in raising corn fodder, and now realize how much I have lost by not having (until now) a proper place to store it for winter use. I have never wintered my stock as cheaply as I have since feeding ensilage."

E. L. LOCKWOOD, PETERSBURG, MICH.

1. Summer of 1888.

2. Of wood, above ground, 30x30x20.

3. Corn only.

4. Location, circumstances, the amount of work, the season, all would modify the question of profit. I planted four varieties—Ohio, or large Dent, Pride of the North, King Phillip, and very small Yellow Flint. This permitted me to plant up to June 17, fully maturing before the heavy frost.

5. Drills.

6. From 6 to 10 quarts, according to variety. If the kernel is large and the stalk small, more seed; if kernel is small and stalk large, less. My corn averaged an ear to each stalk, which I make the object.

7. Fully mature; beginning to glaze or dent.

8. Ten tons. One acre of best land 30 tons.

9. Estimated by your standard per cubic foot settled ensilage.

10. No.

11. Was seven days putting in 150 tons, but put in 40 tons in one day, hoping to know for myself and not for another. Result, sour ensilage. Slow filling saves lateral pressure, and makes sweeter ensilage by generating more heat and settling closer.

12. Ensilage will pack itself, except along the outside. We leave a pile in the center each night as we stop cutting. This will heat rapidly. We fill the corners with this and pack as close as possible.

13. Used two thicknesses of boards, tarred paper between, last year. Shall use only paper next year, with prairie hay, wet straw, chaff, mulch of any kind, the heavier the better.

14. Yes, if you can get the weight on cheaper than you can lose a few inches of ensilage.

15. Seventy-seven cents per ton, exclusive of rent for land. Expect to make it for 50 cents next year.

16. Three months.

17. Perfect, except in two places where boards swelled and raised up, letting the air fall upon the ensilage. This turned black to the depth of six inches in from the end. About three feet further in from the end where the air came in was a white mold. This, although apparently spoiled, was all eaten by the cattle.

18. It was taken out at one end to the depth of five feet at two opposite corners to get at doors opening into mangers for feeding. The ensilage being much looser on top than lower down, took the air, and would re-heat at the edges. But what was left after taking off the top, leaving even surface well packed, did not re-heat or spoil, being left 40 days exposed to the air.

19. Feed once a day, one bushel, mornings, four pounds mixed grain fed

with the ensilage. Corn stalks at noon. Clover hay, six pounds corn and oats, at night, to each cow.

20. Before opening the silo we were feeding shocked corn, ears and all, the same as put into the silo; the same amount of grain and hay, making all conditions as nearly alike as possible, except ensilage and the same corn dried. The result was to increase the milk about 25 per cent, and butter about the same, on ensilage.

21. No.

22. Sheep none. Hogs and horses eat it greedily.

23. No. Storage space about one-fourth.

24. We have a barn holding 150 tons hay, stabling 36 head of cattle, cost $600. Our silo holds 300 tons, stables for 45 head of cattle, cost $600. Think perhaps the barn will last the longer as it is kept dryer. One-tenth of the land or ten times as much fodder per acre, estimating land at $50 per acre, rent should be $3 per acre. Cost of making one ton of hay and putting in barn, 50 cents; cost of raising and putting in silo of 1 ton of corn the same, 50 cents; product per acre, 1 ton hay, 10 tons corn, or 3 tons hay, 30 tons corn. My yield last year would correspond with the above. My advice to brother farmers to build silos is best conveyed in the fact that I expect to build another silo the coming summer. If I can not sell the farms I must make them pay. The silo promises more help in that direction than anything else in my experience.

C. G. AND J. R. LEARNED, PORT AUSTIN, MICH.

1. In 1886.

2. We have three silos, built continuously. No. 1 is 15x15x26 ft. deep. Nos. 2 and 3 are each 10x15x26 ft., all inside measure. The foundations are all alike. We start on rock foundation three feet below the surface and build a good 18 inch cellar wall for the first 10 ft. This we plaster well on inside with best cement, so that it is a good cistern.

On silo No. 1, the next 10 ft. is built of dressed 2x6 hemlock, laid up elevator style. On silos Nos. 2 and 3 this 10 ft. is a balloon frame of 2x6, sheeted on inside with inch boards put on horizontally. These are covered with two thicknesses of tarred building paper, and over this a course of boards put on perpendicularly.

The last 6 ft. of all the silos are just temporary side boards.

All the walls must be plumb.

3. Corn and clover (large red), corn with pease and oats, and corn only.

4. We use Evergreen Sweet and large Western Dent, planted together.

5. In drills 3 feet apart and about 15 inches in the drills.

6. All we need.

7. When the ears are glazed.

8. If all things are favorable "a big pile."

9. Experience.

10. No.

11. We take plenty of time and fill slowly; one day in one silo and the next in the other. We find our ensilage comes out sweeter and in better shape where it has a chance to heat and the gas so generated to escape before covering.

12. We keep one man in the silo to spread the ensilage and see that it is well and closely packed around next the walls.

13. Inch boards; paper between.
14. Yes.
15. No account.
16. Fill from the last of September to first part of October. Generally open November 15th to 20th.
17. No; one.
18. No. We uncover a strip five feet wide and feed from top to bottom of silo, and then open another strip.
19–20. We are feeding 47 milch cows this winter, and the flow of milk is nearly the same as from pasture. Our ration is a cubic foot of ensilage per day to each cow, in two feeds, with bran and shorts on it, and what hay they will eat up cleanly after. Ensilage, only, is too loosening a ration.
21. We have a number of milk customers and they are all well satisfied with the quality and flavor of the milk.
22. Yes. Horses like it, and hogs do well on clover ensilage.
23. Decidedly not. After the farmer has his silo filled he will return to it in the morning and wonder if the bottom has fallen out, and he will have a chance to "round it up" three or four times, and then he may begin to look around his field to see if he has truck enough on the place to fill the "confounded thing." We know, from experience, that 17 acres of good corn can be put in a very small place.
24. It has been a success with us, and we consider it a very satisfactory feed, and the cheapest way to preserve fodder. Yes, if a farmer wants to be in the front, to "get there" he must have a silo, well filled.

MERRILL, FIFIELD & CO., BAY CITY, MICH.

Am sorry to say cannot answer all of the questions as fully as desirable, not having facilities for weighing, etc., and only put up silo as an experiment; but am so well pleased with the result will add another one this fall, and know more about it next year. We would not be without a silo if we only had twenty head of cattle and the cost twice as much.

1. Last summer.
2. Having in our barn a bay 16x32 ft., we made two bins, or silos, 16 ft. square, by boarding up on inside of the joist, leaving an air space of 8 inches, and on both sides of joist, or outside and inside, building paper and boards, then planking up inside with two inch plank to hold it firm, making it 16 ft. square.
3. Corn, sowed.
4. Small eight-rowed yellow, white dent, also southern ensilage.
5. Drills; plugged each alternate tooth of a common wheat drill.
6. Don't know.
7. Cut it just before frost came, getting full growth.
8. We had about five acres, estimated 200 tons.
9. Estimated.
10. No.
11. As fast as we could with one medium sized cutter to get the work done.
12. Men tramp down after each load is cut, only moderately.
13. Building paper and boards.
14. Yes, we filled the small loft over silo with pea straw, that was all the

weighting it had, and that only a month after filling, but am satisfied ought to have left it longer.

15. About 40 cents per ton to put up; can do it for less this year.

16. Opened ours December 2, 1888.

17. Splendid.

18. After feeding two months, taking it out from top to bottom across the silo, the side exposed would mold a little, but would not prevent cattle from eating it.

19. Used it as a midday meal—in the mornings, feed cut straw with a little bran or middlings, then turned out until about 2 or 3 o'clock, then put up, and all grown animals given a bushel basket full of ensilage, and young ones in proportion; then sometimes a little hay at night, not often.

20. No experience can tell.

21. Don't know.

22. No, only horses; it does well with them.

23. No, decidedly, no.

24. Yes, we never wintered our herd so cheaply or satisfactorily as this winter; will add one more silo this summer; we have fed about 60 head from the 5 acres from December 2, 1888, to now, March 5, on one silo 16 ft. square, and have one more silo of same size yet to feed, and think it will feed the herd at least six months, from 30 to 60 bushels a day.

C. F. MOORE, ST. CLAIR, MICH.

1. In 1886.

2. In an old barn, fully described in letter of May 18, 1887.

3. Clover and corn.

4. Southern corn; shall use a Michigan dent this year.

5. Planted in drills 3½ ft. apart and about 40 stalks to the rod. This year shall plant in hills 3½ ft. apart each way.

7. When it commences to glaze.

8–9. Estimated at 20 tons per acre.

10. No.

11. I shall endeavor to fill slowly, thus securing sweet ensilage, which being quite mature and sweet, will, I believe, be much better to feed cows suckling calves. The ensilage I am feeding now, being from the immature corn, and being very sour on account of rapid filling, has, I believe, been bad for my calves. Some have died after suffering from colic, which, I think, was caused by their mothers eating the sour, immature fodder.

13. Two thicknesses of boards, with a layer of tarred paper between.

14. I lost much of my ensilage the second year from a lack of weight.

15. I kept no memorandum.

16. Three months after filling.

17–18. In good condition and kept well after opening.

19. Feed ensilage at noon and night and dry hay in the morning. Most of my cattle have had an allowance of bran middlings and ground oats and corn mixed, night and morning.

20–21. I believe ensilage the very best winter feed for milk production.

22. I have fed my horses and colts ensilage once each day, all winter; also fed dry timothy hay once, but no grain. They have done well.

23. I think more feed can be grown on the same amount of land, and can be stored in less space in the shape of ensilage than any other way. I also believe it the most economical feed that can be produced.

24. I believe every farmer who keeps a dozen or more head of cattle should raise ensilage and have a silo. With well-bred cattle and the silo the farmers of the far west have little, if any, advantage over Michigan farmers.

Under date of May 18, 1887, Mr. Moore writes as follows, concerning his silo and ensilage:

"I only decided to put up some ensilage about a week before it was time to begin filling. I had an old barn that I had no special use for. It had a bay 16x32, which I divided into two parts, put up the girts to nail boards to, then took some old lumber that I had taken from another old barn; these were weather-beaten, of different thicknesses, and a poor lot generally. I put them up and down from the ground to the top. After putting on one thickness of boards I put two thicknesses of tarred paper. I put the two on account of my boards being so poor. Then I put on another thickness of boards, making double boards with paper between. These boards I let into the ground a little to exclude any air which might come in through the bottom. I then put a few loose boards in the bottom for a floor. I began filling by drawing my clover in as we cut it. I used a horse power the first day and found we could not get the clover through the cutter fast enough, the clover therefore became quite dry by night. The next day I got a steam engine, but it did not work well the first half day, so much of the clover in about half of one of the parts became considerably cured. The remainder of that part was put in about as we cut it; the second part was also filled rapidly. It all kept well, both the cured and the other; but we thought that which went in as soon as cut was more as we thought it ought to be, viz: more like green grass. We tramped the whole very thoroughly around the edges, but lost from six inches to a foot all around, also about eight inches on the top. We think the silo ought to have been made of a little better lumber. We also think the next time we fill (which will be this year) we shall put it in as we cut it and not begin cutting till clover is well matured, then will fill rather slowly, tramping well around the edges. We think clover for ensilage ought to be, or rather can be, a little more mature than when cured for hay. There was much less waste in the silo than there was in the cured hay. We think the 36 loads we put in our silo (which we estimated equal to 36 tons of cured hay) went further than twice that quantity of cured hay. I think the silo a success. I think the corn ensilage probably the most profitable, but I think clover ensilage much ahead of clover hay. We feed it twice each day, from December 15 to April 1, to our cattle, and once each day to our colts and mares. Our stock never came through the winter so nicely or so cheaply, and have never been so fat in the spring as this year. Many of our breeding cows are too fat. This may not be due altogether to the ensilage, but we think largely so."

EDWIN PHELPS, PONTIAC, MICHIGAN.

1. Built silo in spring of 1883—11x14x25 feet.

2. It is made by putting up 2x6 studding 18 inches apart, all around, except in one corner, one is omitted for opening from bottom to top, 25 feet. Inch lumber is nailed on inside, then tarred building paper is tacked on,

then dressed pine boards put perpendicularly inside. The opening has short boards fitted in slots so as to come out in filling and emptying. Tarred paper is also used in the opening, as on sides. The studs are supported bottom and top by sill and plate, in the middle by supports in barn. The bottom is cemented with water-lime. After filling, all is covered with inch boards and paper, same as sides, only not nailed.

3. The first year it was filled with clover and orchard grass mixed, cut when clover was in full bloom, and taken up immediately after mower, not waiting for wet from dew or shower to dry off. We have since used corn.

4. Our corn has been mostly common Yankee dent, with some sweet corn; think the large kinds of sweet make the best ensilage.

5. We have, after much experimenting, found planting in hills gives the best results, 3 feet 8 inches one way and one-half as far the other way, making it about twice as thick as common field corn.

6. About ten quarts of seed is enough per acre for me.

7. We find the best results from cutting the corn about the time it begins to glaze and before the leaves begin to die.

8. Our yield has been from 15 to 20 tons per acre.

9. The past season we weighed every load and had nearly 19 tons per acre, and had it not been so very dry the yield would have been much more.

10. We filled, one year, with corn, bound up in small bundles with marsh grass, and found it a very satisfactory way, except that it did not pack as close and more was injured, but it was very convenient to handle.

11. We fill with our usual farm help without hurry, and in case the stuff does not heat up to 110° Fahrenheit over night lay off a day, when it usually gets warmer than that, sometimes 120°, but last year we found, owing to its being very dry weather, it did not heat as rapidly or as much as I deem advisable. I prefer it should heat to about 120°, believing the ensilage is sweeter and packs more solidly. We are now feeding it and find it a little tart. Our stock relish it well, but I prefer it sweeter.

12. We tramp it as solid as possible, especially at the sides and corners, a man being on it while filling.

13. We cover with two thicknesses of boards, with tarred paper between.

14. Weight moderately with barrels of earth, sufficient to keep the cover down close to the ensilage.

15. Have never made any figures of cost, but last year we put in four acres, 75 tons, in four working days, with four men and three teams.

16. We filled the last of September and commenced using about the first of January following.

17. The condition was then about as now, being warm and moist, a little sourer than now, but I believe the difference is owing to the center being more solid and not on account of time.

18. When first opened, it was rank in smell, sourer in taste than after being exposed to the air. We feed from the top, allowing it to air about 12 hours.

19. Have never fed ensilage alone, but in combination with dry feed. Our practice is to put in a feed of ensilage and mix our grain feed with it twice a day; other feeds cut straw or hay during day and at night.

20. Our cows have always increased in milk and butter when we commenced to feed ensilage, and the women think the butter comes more readily when we feed it.

21. Have never seen any evil effects on quality of milk from feeding ensilage, either in smell or taste, but I am of the opinion it would affect it, if fed as a whole feed or in excess.

22. Have fed some to horses and pigs with good results, they learning to eat it readily, even greedily. Am now feeding two horses some every day and their hair is smooth and glossy and they feed well. Have not fed it to sheep. I believe shoats can be wintered on it cheaper and better than on anything else we have at hand.

23. I am satisfied after six years' trial that in no other way can so much coarse fodder be put up in so small or economical a manner, or so acceptably or healthy for stock. The cost of silo is so small, and the room it occupies so little, no special protection against frost being necessary.

24. There seems to me no doubt of its utility, and I can heartily recommend to my brother farmers, however small their farms may be, to put in a silo and fill it once. Then I guarantee they will never do without one or more. The cost of a silo that will hold 100 tons need not be over $50, and will be a constant source of profit and comfort.

MARTIN L. SWEET, GRAND RAPIDS, MICH.

1. I built my first silo in July, 1886.

2. It is 36 feet long and 18 feet wide, with a stone wall under it, 8 feet high, laid up with Buffalo cement, and made air tight, and plastered on the inside the same as a cistern. Then I put a wall in the center across the shortest way, leaving the two parts 15x16 feet, and then I put a wooden structure on top with studding 2x10 and 18 feet long. I ceiled it up with common matched flooring on the outside. On the inside I used two inch plank dressed on the inside, plowed and tongued, and spiked onto the studding all round, and on both sides of the partition. I put on an ordinary shingle roof, one-third pitch, with a door 3 feet by 6 in. each, gable end, and then on the sides, for the purpose of taking out the ensilage; had three doors, one above the other, 3 feet wide and 6 feet high each, and hung with ordinary strap hinges.

3. Corn. I have experimented with nearly all kinds.

4. I would recommend Minnesota early sweet corn, and Stowell's evergreen, in equal parts or half and half.

These varieties have proved most satisfactory.

5. I plant in drills, 3 feet one way and 4 inches the other, and one stalk in a place.

6. One-half bushel to the acre.

7. I let the corn stand until perfectly ripe and cut before the frost touches it.

8. About 25 tons to the acre.

9. It is weighed.

10. Never put corn in uncut.

11. I put in about 40 tons a day, commencing and filling one side of my silo, and then the other side. (This silo being divided into two compartments.) I think it makes but little difference whether you pack in slow or fast; the only advantage in packing slowly is that more time is given for the filling to settle.

12. Yes; as one man can do it. Be sure and keep the outside edges well tramped down while packing.

13. When completed I put on about a foot of straw, then lay on top of that ordinary two inch plank.

14. Weight with stone or with whatever is most convenient. Moderate weight; many say it is not necessary to weight at all, but I have not tried that.

15. To cut and put into the silo, the ensilage cost 35 cents per ton.

16. This year I began to feed six weeks after it was put into the silo, and took the weighting and covering all off the side from which I began to feed.

17. The condition of the ensilage was perfect; no waste at all.

18. It did not change at all after opening.

19. I fed ensilage in connection with other feed, but separately, as to time of feeding.

20. For milk and butter I would not do without it, the quality being as good as from June grass. I am getting as good butter and as much of it as when the cows were fed on June grass.

21. It is certainly efficient, for it makes the best of milk and butter.

22. Have had no experience in feeding to sheep or horses, but think it would be good for either.

23. No; do not believe it can be stored as cheaply in any other way. I do not think any farmer in the country can afford to do without one.

I use an ordinary Ross cutter, with carrier to put the ensilage into the silo. I use a reaper, with dropper, in the field to do the cutting. One team will cut with machine as fast as six men can put it on the wagons. I cultivate with an ordinary cultivator the same as ordinary field corn. I make the land very rich on which I grow the corn, consequently more or less weeds will come up in the rows between the stalks, and, until this year, I have let them grow, and they were gathered with the corn, believing that the seed would not grow after coming from the silo; but finding that the corn would grow after coming from the silo, I concluded not to trust the weeds this year, and pulled them out before cutting the corn.

JOHN P. SANBORN, PORT HURON.

In Mr. Sanborn's absence Mr. Wastell replied briefly to the inquiries.

1. Fall 1884.
2. Of 2x6 plank, planked inside and boarded outside, filled between with sawdust.
3. Corn.
4. Southern sweet corn.
5. Drills two feet apart.
6. Two bushels.
7. At about ten weeks old.
8. Thirty tons.
9. Weighed.
10. No.
11. As fast as possible.
12. Yes.
13. Plank.
14. Yes.
15. Fifty cents per ton.
16. Six weeks.
17. Warm.
18. No.
19. Ensilage and straw.
20. Good.
21. No.
22. Horses.
23. No.
24. Yes; yes.

JAMES M. TURNER, LANSING, MICHIGAN.

1. I built two silos during the season of 1888.

2. Our largest silo was constructed of wood on a stone foundation. Foundation was 3 feet high above ground, with 2x10 bond timber laid on top and bolted into mason work Size of building 28x40, divided in the middle. Studding 2x10, 22 feet long, with three courses of bridging. Covered studding with two thicknesses of tarred building paper, and sheeted inside with cheap hemlock flooring, dressed and matched, put on horizontally. Outside was covered with 1x6 ship-lapped hemlock strips, dressed. Painted outside with iron ore paint, and inside was painted with hot pitch and coal tar. My smaller silo was made by simply sealing up with common flooring an old bay in the barn.

3. Corn was used for the ensilage.

4. We used large, white Southern corn, as well as smut nose flint corn. Was well satisfied with each. White Southern corn grew larger stalks; but other variety produced a larger yield of ears, which about balanced their value.

5. I planted in drills three and a half feet apart, with Challenge two-horse corn planter, manufactured at Grand Haven, Michigan.

6. Do not remember just how much seed was used, but drill was set to drop a kernel every two or three inches. This provides not only for ensilage, but also for the cut-worms and blackbirds.

7. Our corn last year was cut very late, after it was dead ripe; the severe drought having hastened its maturity. We also had several heavy frosts before ensilage was secured.

8. Our yield per acre varied from 20 to 35 tons.

9. This yield is estimated after weighing perhaps a dozen loads.

10. Have never tried filling silo with uncut corn, as I should consider it much more expensive to handle in feeding out.

11. Our largest silo held about 400 tons, and was filled daily from start; our Smalley cutter cutting about ten tons per hour, while filling was going on.

12. We had one or two men tramping down the ensilage after first day, using particular care in getting corners and sides well packed; we found center would take care of itself.

13. When silo was filled we covered with common inch boards, then laid another course of inch boards crosswise, and loaded heavily by rolling on old sugar barrels filled with sand.

14. I should approve of considerable weight, in order to properly compress top of ensilage. Of course, where silo is deep, the weight of the ensilage affords sufficient compression for the bottom; but I think it is an advantage to use weights to properly compress the top and exclude the atmosphere.

15. We estimated that our ensilage cost about 75 cents per ton, ready for feeding.

16. Our silo was opened and feeding began from it about four weeks after it was filled.

17. The condition of the ensilage had not, to the eye, changed in appearance since putting in, although a strong odor similar to old molasses was quite noticeable.

18. Have noticed no change in appearance or character since opened.

19. We feed our cattle ensilage twice each day, giving to each animal each time a full bushel basket, together with about four quarts of bran mixed with it. A small ration of hay is given to the same animals once a day.

20. We think our cows gave more and better milk on ensilage than on any other feed we have tried.

21. Could discover no deterioration in quality of milk since feeding ensilage.

22. Our horses and sheep have relished the ensilage quite as much as the cattle, and it seems to entirely agree with them.

23. Certainly no other process with which we are familiar will permit of storing an equivalent amount of fodder as cheaply as in the silo.

24. My experience thus far with the ensilage is more than satisfactory, and it appears to me to be a new way out of the woods for the farmers who have so long been suffering from depression in prices of all classes of farm products. It seems to me that the only hope of future success lies in cheapening the methods of production.

I believe Michigan farmers, through the aid of silos and ensilage, may be able to keep a cow on every acre of tillable land. The ensilage is as available in summer as in the winter; and I don't think we can now afford to pasture our stock, but that the dairy cows will give greater results when fed ensilage, and merely allowed to run out long enough each day to afford proper exercise; and I believe, that by availing themselves of this new system, our farmers who have been keeping ten cows can better keep fifty. The same would apply to feeding steers, or to growing sheep or horses. If our most fertile lands properly treated can be made to produce 35 tons per acre of ensilage, no one can afford to rely upon one or one and a half tons per acre of hay. Neither can they afford to devote the additional area necessary for pasturage.

My impressions are that the silo has come to stay, and that the farmers and stockgrowers will, through its aid, be raised out of their difficulties.

Extract from letter of D. N. Blocher, Millington, dated Jan. 12, 1888:

My silo is 11x14 and 16 ft. deep. Five and one-half feet of it, below the sill of my barn, is made of an 18 inch stone wall, sand and water-lime bottom, six inches of same material above the sill, studded and sheeted on the inside with inch lumber, this lathed and plastered, using one barrel quick and one-half barrel water-lime. Commenced filling September first with corn, about three and one-half feet; then let it stand four days, filled three feet, let it stand three days, then filled as before, and so on until corn was all in. Got the silo about two-thirds full. Put on top six inches poor hay well trod down. Then I covered with boards and plank and weighted with about three tons of stone. Commenced feeding Nov. 26. I keep Jersey cows. Before I commenced feeding ensilage I fed to each cow one bushel of mangolds per day, say about 60 pounds, and all the good hay they would eat. Then I fed 10 pounds ensilage and about one-fourth the amount of hay I had been feeding. In one week the flow of milk increased 25 per cent, equal to what it was in August, and the quantity is very regular, not varying three pounds per day from eight cows, until about five days ago they began to shrink, so that at this date (Jan. 12) they have fallen off 15 per cent. The cause I cannot fully determine. Four calved in April, the balance in June and July. This may be part of the trouble. But about a week ago I allowed them to run to a stack of oat straw about three hours a day. The ensilage was not injured by heating, but in digging down I find it spoiled in two corners of the silo, perhaps a ton in each, by not being tramped down solid when put in, and in the way I filled those corners contained mostly leaves of the corn.

EXPERIMENTS WITH ENSILAGE VS. CORN HARVESTED IN ORDINARY WAY.

Is an acre of corn, put in the silo, worth more to feed cattle, than if cut and dried in the ordinary way, feeding the grain and fodder in combination? The experiment herewith reported was undertaken with the hope of securing some information on this much mooted question.

Last September one and a half acres of good ensilage corn, sowed thin in the drill (of Hathaway and Hibbard varieties, seed mixed) and well eared, was cut up when nicely glazed, weighed and put in our small silo. From the one and a half acres 25,060 pounds of corn ensilage were obtained. One and a half acres adjoining, and to all appearance equal in every respect, was cut and shocked in the ordinary way. When dry, in October, the corn on last named plat was husked and 5,310 pounds of fairly dry corn was obtained, much of which was sound. The stalks were bound and shocked and left until fairly dried. When drawn to the barn and put away for winter feeding they weighed 5,975 pounds.

Five cows giving milk were placed on the east side of the experimental barn and five dry cows in the stalls on the opposite side.

Two of the milch cows were Shorthorns, two Holsteins and one Ayrshire. Four of the dry cows were Shorthorns, the other a Devon.

The following brief descriptions of the animals give some items necessary for the best understanding of some points of the experiment:

Phœnix 12th, Shorthorn, calved Nov. 12, 1877; last calf July 13, 1888.

Lulu of Lansing, Ayrshire, calved Nov, 18, 1878; last calf May 12, 1888.

College Phœnix 2d, Shorthorn, calved Nov. 7, 1885; last calf Sept. 15, 1888.

Soutje, Holstein, calved Nov. 18, 1878; last calf April 2, 1888. Soutje was dried off Feb. 28, and had been milked but once daily for a week before.

College Mae, Holstein, calved June 3, 1884; last calf Oct. 2, 1888.

Bonny Red Rose 2d, Shorthorn, calved Oct. 12, 1874; last calf June 17, 1888.

Crystal Queen 9th, Shorthorn, calved June 7, 1876; last calf Jan. 5, 1888.

Heroine, Shorthorn, calved March 18, 1876; last calf Jan. 5, 1888.

Jennie Baldwin 2d, Shorthorn, calved Jan. 15, 1885; last calf Oct., 1888.

Lovely 27th, Devon, calved July, 1877; last calf May 14, 1888.

After a week's preliminary feeding the experiment began Dec. 15, 1888. Dried cornstalks were fed for a period of three weeks, then ensilage was substituted for the dried fodder for three weeks, then returned to dried fodder the third period, and then ensilage the fourth period, making two periods each of three weeks for dried fodder and the same for ensilage.

The dried fodder was run through the cutting-box; the corn was crushed and the cob meal fed with the dried stalks, while an equal amount of bran and two pounds of clover and timothy hay were fed daily with both dried fodder and ensilage. Each ration was weighed, and whatever was left was weighed back. Only the actual amount consumed is reported. Careful records were kept of each milking, and the cows were weighed each week.

Tables one and two give names of the animal, date of period, grain, hay, ensilage and dried fodder consumed; pounds of milk, weight of animals at beginning and close of periods, with gain or loss.

The milch cows were in that time from calving, when there is quite a marked shrinkage in product, and one was entirely dry before the completion of the test. See milk yield of Soutje in tables.

Four of the dry cows were old and had suckled calves until late in the fall, and were much reduced in flesh, so that the gains were light during the first periods of feeding.

During the dry fodder periods the daily grain ration was 14 pounds to each cow, made up of varying amounts of wheat bran and cob meal, averaging five pounds of bran, two pounds of hay daily, and what corn fodder they would consume.

During the ensilage periods the daily ration was five pounds of wheat bran, two pounds of hay, and from 30 to 60 pounds of ensilage.

TABLE I.—*Dry Feed alone.*

Name of animal.	Date of periods.	Grain—lbs.	Hay—lbs.	Dried corn fodder—lbs.	Milk—lbs.	Weights.			
						At beginning of period, Dec. 14.	At close of period.	Gain.	Loss.
Phœnix 12th	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 336	42 42	278 205	398 383	1,210 1,195	1,150 1,170	....	60 25
College Phœnix	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 336	42 42	280½ 222	501½ 441½	1,070 1,050	1,020 1,040	....	50 10
Lulu of Lansing	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 336	42 42	265½ 197	327 286½	920 960	880 985	 25	40 ....
Soutje	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 336	42 42	361½ 344	326 111½	1,250 1,305	1,230 1,360	 55	20 ....
College Mae	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 336	42 42	293 305	579 511	1,120 1,180	1,080 1,180	 0	40 0
Bonny Red Rose 2d	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	246 335½	42 42	97 165½	....	1,120 1,247	1,180 1,295	60 48	....
Crystal Queen 9th	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 335½	42 42	238½ 157	....	1,500 1,505	1,510 1,505	10 0	 0
Heroine	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 335½	42 42	211½ 174½	....	1,180 1,220	1,160 1,208	....	20 12
Jennie Baldwin 2d	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 335½	42 42	241½ 207½	....	1,230 1,290	1,230 1,320	0 30	0 ....
Lovely 27th	Dec. 15 to Jan. 4 Jan. 26 to Feb. 15	252 335½	42 42	156 145	....	1,090 1,080	1,080 1,140	 60	10 ....
Totals	....	5,871½	840	4,545½	3,865	......	......	288	287

TABLE II.—*Dry Feed and Ensilage.*

Name of Animal.	Date of Periods.	Grain—lbs.	Hay—lbs.	Ensilage—lbs.	Milk—lbs.	Weights.			
						At beginning of period.	At close of period.	Gain.	Loss.
Phœnix 12th	Jan. 5 to Jan. 25	126	42	911	369½	1,150	1,195	45	----
	Feb. 16 to March 8	84	42	823	339	1,170	1,110	------	60
College Phœnix	Jan. 5 to Jan. 25	126	42	876	462½	1,020	1,050	30	----
	Feb. 16 to March 8	84	42	823	376½	1,040	1,020	------	20
Lulu of Lansing	Jan. 5 to Jan. 25	126	42	911	299½	880	960	80	----
	Feb. 16 to March 8	84	42	823	247½	985	970	------	15
Soutje	Jan. 5 to Jan. 25	126	42	1,171	255½	1,220	1,305	75	----
	Feb. 16 to March 8	84	42	1.148	20½	1,360	1,400	40	----
College Mae	Jan. 5 to Jan. 25	126	42	1,171	545	1,080	1,180	100	----
	Feb. 16 to March 8	84	42	1,148	464	1,180	1,170	------	10
Bonny Red Rose	Jan 5 to Jan. 25	126	42	842	--------	1,180	1,247	67	----
	Feb. 16 to March 8	84	42	823	--------	1,295	1,370	75	----
Crystal Queen 9th	Jan. 5 to Jan. 25	126	42	872	--------	1,510	1,505	------	5
	Feb. 16 to March 8	84	42	618	--------	1,505	1,470	------	35
Heroine	Jan. 5 to Jan. 25	126	42	930	--------	1,160	1,220	60	----
	Feb. 16 to March 8	84	42	823	--------	1,208	1,235	27	----
Jennie Baldwin 2d	Jan. 5 to Jan. 25	126	42	975	--------	1,230	1,290	60	----
	Feb. 16 to March 8	84	42	968	--------	1,320	1,330	10	----
Lovely 27th	Jan. 5 to Jan. 25	126	42	548	--------	1,080	1,080	0	0
	Feb. 16 to March 8	84	42	578	--------	1,140	1,150	10	----
Totals	----------------------	2,100	840	17,782	3,379½	------	------	679	145

TABLE III.—*Totals by Groups.*

Group.	Period.	Food Consumed—Pounds.							Milk. Pounds.		Gain + or Loss –. Pounds.	
		Hay.	Bran.	Corn and cob meal.	Dried corn fodder.	Ensilage.	Total.	Daily average per cow.	Total.	Daily average per cow.	Total.	Aver. per cow.
5 milch cows	1st 3 weeks	210	624	636	1,478½	------	2,918½	28.1	2,131½	20.3	–210	–42
" "	2d "	210	630	------	--------	5,040	5,880	56	1,932	18.4	+330	+66
" "	3d "	210	336	1,344	1,273	------	3,163	30.1	1,733½	16.5	+ 45	+ 9
" "	4th "	210	420	------	--------	4,765	5,395	51.4	1,447½	13.8	– 65	–13
" "	1st & 3d 3 wks	420	960	1,980	2,751½	------	6,111½	29.1	3,865	18.4	–165	–33
" "	2d & 4th "	420	1,050	------	--------	9,805	11,275	53.7	3,379½	16.1	+265	+53
5 dry cows	1st 3 weeks	210	620	634	944½	------	2,408½	22.9	--------	------	+ 40	+ 8
" "	2d "	210	630	------	--------	4,167	5,007	47.6	--------	------	+182	+36
" "	3d "	210	335½	1,342	849½	------	2,737	26.1	--------	------	+126	+25
" "	4th "	210	420	------	--------	3,810	4,440	42.2	--------	------	+ 87	+17
" "	1st & 2d 3 wks	420	955½	1,976	1,794	------	5,145½	24.5	--------	------	+166	+33
" "	3d & 4th "	420	1,050	------	--------	7,977	9,447	45	--------	------	+269	+54

It will be seen that the milch cows gave 485½ pounds more milk on dry fodder than ensilage. This is, in a measure, accounted for by the natural shrinkage. This may be seen by comparing the yield for the first period of ensilage feeding with the second period of dried fodder immediately following. The greater yield was during the feeding of ensilage, showing that the decrease was the natural result of the lengthening of the period of lactation. Soutje drying off during the last period on ensilage should also be taken into consideration.

The 1½ acres of corn made 25,060 pounds of ensilage, 21,125 pounds were weighed from the silo, a little more than one-eighth of loss.

Of this 21,125 pounds, 15,890 pounds, or about three-quarters, were fed, the remaining 5,235 pounds being classed bad. There was waste and loss in being obliged to cart it from the silo to the barn where it was fed; 1,892 pounds from another silo was required to complete the last four days of the feeding.

The acre and a half of ensilaged corn, therefore, furnished the bulk of the food of ten cows for nearly six weeks. From 1½ acres was obtained 5,310 pounds of grain fairly dry. The stalks when put into the barn, November 23, weighed 5,975 pounds. The total weight of grain and stalks was 11,285 pounds, not quite half the weight of the corn ensilaged.

The first load was put into the experimental barn Dec. 14, the last Jan. 31, they having been stored in the grain barn in the meantime. The total weight was 5,625 pounds, a shrinkage of 350 pounds from Nov. 23. These lasted until Feb. 6, when stalks grown in another field were drawn to be used with the remainder of the cob meal, making something like a week of feeding from the latter; 6,313 pounds were weighed out to the cows in the six weeks when dried fodder was fed, and they consumed 4,545 pounds, a waste of 1,768 pounds, the larger, coarser parts of the stalks not being eaten.

The 5,310 pounds of corn in the ear made 4,219 pounds of corn and cob meal.

The ten cows consumed 3,955 pounds of corn and cob meal, 264 pounds less than the full amount—not a very great difference when two facts are considered: One lot of meal was very damp, and was spread and turned frequently, and there was a large shrinkage; for the feeding of the ten cows three times daily for six weeks, or 42 days, 1,260 weighings were necessary. In so many weighings there would necessarily be some loss.

The experiment shows that the ensilage, although nearly a quarter of it had spoiled from a lack of care in filling and partly from exposure during the interim of dried fodder feeding, lasted longer than the stalks and corn and cob meal, that the cows made more pounds gain on it than on the dried fodder and meal. There can be no doubt that it was cheaper. The fact of the greater number of times the dried stalks were handled over more than the corn made into ensilage, and the labor of husking the corn would add to the cost of the dried fodder. The hauling of the corn and crushing into meal would also add to the cost.

The following items embrace the cost of preparing the corn fodder in the ordinary way:

Cutting and shocking one and one-half acres at $1.00	$1 50
Husking 106 bushels ears and cribbing same at four cents	4 24
Drawing 5,975 pounds of corn stalks to barn	1 50
Cutting of same at 75 cents per ton	2 25
Drawing two loads of corn to mill, and meal home	2 50
To crushing and grinding 5,310 pounds of corn at 10 cents per 100	5 31
Total cost	$17 30

The cost of one and one-half acres of corn, or 12½ tons of ensilage, in silo at 70 cents	$8 75

Which would leave a balance of $8.55 in favor of ensilage.

The labor of feeding the ensilage all prepared and mixed will be much less than in feeding the dried fodder. Some who favor the dried fodder may object to the expense involved in cutting. If the fodder should be fed long and the grain unground, even then the cost would be only $1.00 less per acre than the ensilage. There are few feeders who would consider it economical to feed the corn in the ear.

COMPARATIVE TEST OF VARIETIES OF ENSILAGE CORN.

Comparative test of varieties to determine their value for ensilage.

Those who have been most successful in making good ensilage prefer a variety of corn that produces both a large amount of good fodder and ears in the roasting stage or just beginning to glaze.

Several varieties, recommended for ensilage, were planted for the purpose of determining which, in our climate and on our soil, most perfectly combined these two points.

The soil, a sandy loam, was thoroughly prepared for the crop.

On May 19, 1888, the following varieties were planted in drills 3 feet 9 inches apart: Deitz Golden Yellow, Golden Beauty, White Giant Normandy, Breck's Boston Market, Wisconsin White Dent, Leaming Yellow Dent, Chester County Mammoth, Southern Ensilage, Parish White Dent. Owing to unavoidable delay in receiving the seed, the Burrell and Whitman was planted some two weeks later than the other varieties, as was also Sweet's, the seed of which was obtained from Hon. M. L. Sweet, of Grand Rapids, who has grown it several years and found it an excellent variety. The weeds were kept down by thorough cultivation during the entire growing season.

The yield of corn was lessened by the severe drought, prevalent a good part of the season. The following notes, made during the growing season, will aid in giving some idea of the habits of growth of each variety.

Deitz Golden Yellow.

June 20.—Has not made rapid growth; has a good stand; the leaves are ong, narrow and good color.

June 28.—Seventeen inches high.

July 2.—Height of two feet.

July 23.—About five feet high; has made an even growth. The stalks are medium size and well leaved.

Aug. 4.—Five to seven feet high. Beginning to tassel.

Sept. 4.—Beginning to turn; some stalks quite dry half way to top, others green to the ground; ears beginning to fill; 21 stalks per rod; 8½ feet high; 71 ears to 100 stalks in drill.

White Giant of Normandy.

June 20.—Has made a fair growth; has a good stand; is not so well leaved as some of the others.

June 28.—Twenty-three inches high.

July 2.—Dark green; thrifty stalk; four feet high.

July 23.—One of the largest and coarsest varieties grown; stalks very heavy, with a good supply of coarse leaves.

Aug. 4.—From 5 to 10 feet high; nearly all tasseled.

Sept. 4.—Stalks partially dried; ears well filled with grain in the milk; 19 stalks to the rod, 8½ feet high; 82 ears to 100 stalks in drill.

Golden Beauty.

June 20.—Has a fair stand.

June 28.—Doing well; 17 inches high.

July 2.—Even growth; height 2½ feet.

July 23.—Uneven; from 2 to 5 feet high.

Aug. 4.—Rather thin in drill; large, coarse leaves and stalks.

Sept. 4.—Ears in roasting stage and well filled; stalks still green but turning in some places; 17 stalks per rod, 8½ feet high; 68 ears to 100 stalks in drill.

Breck's Boston Market.

June 20.—Fair stand; seed was not good.

June 28.—Thin in drill; healthy growth; 17 inches high.

July 2.—Two and a half feet high.

July 23.—The tallest stalks are 6 feet high; large, heavy stalks, well leaved; suckers coming up in abundance about the roots.

Aug. 4.—Rather late.

Sept. 4.—Turning some; ears fairly filled; grain in the milk; 17 stalks per rod; 8 feet high; 82 ears to 100 stalks in drill.

Wisconsin White Dent.

June 20—Good color and has made a good growth.

June 28.—Even growth; 22 inches high.

July 2.—Dark color, 2½ feet high.

July 23.—Stalks from 4 to 6 feet high; half the stalks tasseled.

Aug. 4.—Earliest of all; ears formed and silked; large stalks 6 to 8 feet high.

Sept. 4.—Ripening fast; almost out of the roasting stage; 21 stalks per rod; 7 feet high; 85 ears to 100 stalks in drill.

Leaming Yellow Dent.

June 20.—Dark color; has made good growth.

June 28.—Twenty-two inches high.

July 2.—Even growth and of good color.

July 23.—Taller than any other variety; fine stalks.

Aug. 4.—Stalks well leaved; 5 to 8 feet high and tasseling.

Sept. 4.—Half ripe; grain beginning to glaze; 25 stalks to rod; 8¾ feet high; 62 ears to 100 stalks in drill.

Chester County Mammoth.

June 20.—Over 12 inches high. Large, strong stalk and broad leaf.

June 28.—Twenty-two inches high.

July 2.—Vigorous and even growth; 3 feet high.

July 23.—Over 6 feet in many places; stalks finer than Parrish dent, fairly well leaved. A large amount of fodder will be obtained.

Aug. 4.—Five to eight feet high, and tasseling.

Sept. 4.—Stalks half ripe. Grain in the milk; 22 stalks to rod; 8¾ feet high; 48 ears to 100 stalks in drill.

Southern Ensilage.

June 20.—Ten to 12 inches high.

June 28.—Even growth; 22 inches high.

July 2.—In the main, vigorous growth and good color.

July 23.—Five and a half feet high in best places.

Aug. 3.—Later than other varieties; 7 feet high and very green.

Sept. 4.—Ears scarcely formed in many places; stalks drying at roots; 24 stalks to rod; 8½ feet high; 29 ears to 100 stalks in drill.

Parrish White Dent.

June 20.—Good color and stand; 10 to 12 inches high.

June 28.—Thin in drill, with many small stalks; 22 inches high.

July 2.—Two and a half to three feet high.

July 23.—Five and a half feet high in best places; stalks are large and quite well leaved; coarser than Southern ensilage.

Aug. 5.—About 7 feet high; still green.

Sept. 4.—Ears fair size, fairly filled; grain in the milk; 23 stalks per rod; 33 ears to 100 stalks in drill.

Burrill and Whitman's.

June 20.—Growing rapidly; has good stand; sown two weeks later than other varieties, but seems likely to outstrip them.

June 28.—Has made even growth; 22 inches high.

July 23.—Four and one-half to five feet high. The stalks are medium size with many long, narrow leaves. More leaves than any other variety.

Aug. 4.—Five to eight feet high.

Sept. 4.—Turning rapidly, only tops still green; 31 stalks to rod; seven and one-half feet high; four ears to 100 stalks in drill.

Sweet's.

Sept. 4.—Leaves green; ears just forming; seven and one-half feet high. This is doubtless the result of the late planting.

The Hathaway Dent.

This is a variety of field corn that has been grown for some years on the College farm. That referred to in the table was grown in the same field and under the same conditions as those already noted.

The following table gives, in summarized form, the following points of comparison:

Number of rows, height of stalk, number of stalks per rod, number ears to 100 stalks, date of cutting, weight when cut, weight of one row.

The height, number of stalks per rod, number ears to 100 stalks and weight of one row are averages. Yield per acre is estimated from weight of one row. The corn was cut, weighed, prepared and placed in the silo Sept. 4, 5 and 6.

B. and W. and Sweet's are placed in the table to show amount of fodder obtained.

Name and Variety.	Date of planting.	Number of rows.	Height of Stalks.	Number of Stalks per rod.	Number ears to 100 stalks.	Date of cutting.	Weight when cut.	Weight of one row.	Estimated yield per acre.
Wisconsin White Dent	May 19	2	7	21	85	Sept. 5	1,025	512½	18,320
Hathaway	" 19	...	......	20	86	....	....	....	....
White Giant Normandy	" 19	4	8½	19	82	Sept. 6	2,820	705	22,560
B's B. Market	" 19	3	8	17	82	" 5	1,440	480	15,360
Deitz Golden Yellow	" 19	2	8½	21	71	" 6	1,250	625	20,000
Golden Beauty	" 19	3	8½	17	68	" 6	1,780	593⅓	18,986
Leaming Yellow Dent	" 19	4	8¾	25	62	" 5	2,600	650	20,800
Chester Co. Mammoth	" 19	4	8¾	22	48	" 5	2,640	660	21,312
Parrish White Dent	" 19	6	7	23	3[illegible]	" 4	4,945	824⅙	26,373
Southern Ensilage	" 19	4	8½	24	29	" 5	3,205	801¼	25,640
B. and W.	June 1	4	7½	31	4	....	2,655	663¾	21,240
Sweet's	" 1	6	7½	......	3	....	3,580	596⅔	19,093

While the Wisconsin White Dent did not grow so tall as some of the other varieties, and did not have so great number of stalks to the rod, it gives the largest number of ears, and reference to the notes shows that they were nearly out of the roasting stage Sept. 4.

The Hathaway almost equals it in regard to stalks and ears. There are no notes on the condition of the grain, but it is a later variety, and the grain was probably less valuable at this time for the silo.

White Giant of Normandy is also a rival. While the number of stalks per rod, and ears per 100 stalks are not so large, it grew higher and the average weight of a row is 200 pounds more than that of a row of Wisconsin White Dent. The grain was not quite so ripe, but was good.

Breck's Boston Market compares favorably with the two mentioned, except in weight. This cannot be attributed to the fact that it was drier, for it was the greenest of the three when cut.

For convenience we will group Deitz Golden Yellow, Golden Beauty and Leaming Yellow Dent. A glance at the table shows that the height of the three varieties was nearly the same. The number of stalks per rod varies from 17 to 25, and of ears per 100 stalks from 62 to 71. The Leaming, with the greatest number of stalks, has the least number of ears. Golden Beauty, the least number of stalks and more ears than the Leaming; fewer than the Deitz. The Leaming was the ripest, the Deitz the greenest. It will be noted that the weight of a single row of the several varieties varies considerably.

The Chester County Mammoth, the Parrish White Dent and the Southern Ensilage gave a small amount of grain.

The Chester County Mammoth and Parrish White Dent, however, had ears fairly filled and the grain was in the milk. Most of the ears on the Southern Ensilage were just formed.

It would be unfair, because of their later planting, to compare the B. & W. and Sweet's with those mentioned, although the weights show that there was a large quantity of fodder from these two varieties.

The earing of the different varieties plainly enforces the value of thin seeding to secure the best and largest product, of combined grain and stalk, suitable for ensilage.

From 17 to 21 stalks per rod, giving the greatest number of ears per 100 stalks, or from 68 to 86. And it will also be noted that the ears were more mature than the others.

The B. & W., with 31 stalks to the rod, gives only 4, but the lateness of planting may be in a measure the cause of this.

The Leaming, with 25 stalks to the rod, gives 62 ears, while the Southern Ensilage, the Chester County Mammoth and the Parrish White Dent, with a less number of stalks to the rod, also give a fewer number of ears to 100 stalks.

FORAGE PLANTS.

The following forage plants were grown last season. Only small plats were sown, as the test was mainly to determine how they would thrive on our soil and in this climate.

The soil was like that on which the corn was planted, and was prepared in the same manner.

Seed was sown May 19. Most of the seeds were received from the United States Department of Agriculture.

Serradella—This plant made very little growth, which may, perhaps, be accounted for by the drought, as Dr. Goessmann, of the Massachusetts experiment station, reports it as doing best on moist, deep, sandy soil. He also reports it as yielding about ten tons of green fodder to the acre, of which one-fifth was actual vegetable matter. Time of seeding and mode of cultivation are about the same as for peas. The growth of the plant is slow until it blooms, when it rapidly increases in size and nutritive constituents. The close of the blooming period (about September 1, in Massachusetts) is the best time for cutting the crops.

Director Armsby, of the Pennsylvania experiment station, reports "That the plant yields about the same amount of starch and fat per acre as clover hay, but much less of every other nutriment except the ash or mineral elements, which were present in great abundance."

Spergulum Maxama grew rapidly for a time, but was injured by the dry weather.

Sheep Fodder Vicia Velosa, a spreading plant that grows close to the ground and resembles the vetch.

Yellow Lupine made a good start, but made little growth afterward.

Vetches.—These were still green Sept. 14 and had a few pods, but the growth was small.

Brazilian Flour Corn.—The field notes speak of this variety as looking like common corn. Grew slowly and stooled more than common corn. The leaves were narrow and rolled close with a rough inner surface. Sept. 14 it was still green and the ears were just forming.

Kaffir Corn.—A variety of sorghum, cultivated for both forage and grain. Two rows were drilled and two planted in hills. It did not grow so well as some of the other varieties. The drilled was the better during the entire season. Grew to a height of five and one-half feet. The stalks were covered with a substance that rubbed off readily and looked and felt like flour. No ears formed.

Camaroon Corn.—This somewhat resembled millet and made a good growth until July 23, when it seemed somewhat affected by the dry weather. The stalks were about as large as an ordinary lead pencil. Averaged three and one-half feet in height. A few soft, bushy heads, covered with red hairs. Did not resemble any of the other varieties of corn.

Teosinte (*Euchloena luxurians*).—Seed was sent from the United States Department of Agriculture with the following description: "A luxuriant forage plant which has not yet become sufficiently acclimated to produce seed north of Florida or the thirty-first degree of latitude. An annual crop of green or dry fodder or ensilage can be grown as far north as the fifty-first parallel. Stock of all kinds are exceedingly fond of it, either green or cured." It grew to a height of four and one-half feet. Stalks were small with long, narrow leaves.

The Brazilian Flour, the Kaffir, the Camaroon corn and the Teosinte were all sown too thick, and would doubtless have given better results with less seed.

The Caucasian Prickley Comfrey has been very highly spoken of as a forage plant by some of the stations. It, however, did not give promise of great value here. Prof. Brown, of Guelph, Ontario, who has given it a thorough trial, decided it was of little value to them.

From the results obtained it will be seen that very few of these plants merit another trial.

The comparison of these plants with the ensilage corns, growing side by side, taught very emphatically the lesson that with our climate and soil, corn is far superior as a forage crop.

The majority of evidence is in favor of corn for ensilage that is nearly, if not quite, mature. Few of the plants had more than small heads just formed, while many of them had none. Either fact would make them of little value for ensilage.

GRASSES AND CLOVERS.

One acre plats of the following grasses and clovers were sown in experimental field No. 3. The ground is rather sandy, especially where the Alfalfa is sown. It received a good dressing of manure, and was plowed seven inches deep, harrowed, rolled and sown with a wheelbarrow drill and covered with the Vaughn flexible harrow. The ground was again rolled, leaving it very smooth.

Plat No. 1 (one acre) was sown with four bushels of Orchard grass seed. It came up in about two weeks and made a fine growth, covering the ground June 9. This grass kept the start of the weeds which came up more or less all over the piece.

Plat No. 2 (one acre) was sown with 20 pounds Alfalfa seed. This came up in one week from date of sowing and continued to grow, and June 9 covered the ground fairly well. The highest plants were four inches above the ground, and the roots extended lower than this below the surface. A frost on the night of June 1 injured the Alfalfa to quite an extent.

From the appearance of this plat I would sow more than 25 pounds of seed rather than less.

Plat No. 3 (one acre) was sown with 3 bushels of Red Top. This seed came up in about three weeks. It seemed to take longer to germinate than either the Orchard grass or the Alfalfa. It covered the ground June 9, having made a very good start.

Plat No. 4 (one acre) was sown with a mixture of 1 bushel Red Top, 4 quarts Red clover, 4 quarts White clover, 2 quarts Timothy, and 4 quarts Alsike clover, this mixture making nearly 4 bushels in bulk. The clover was up in about a week. The grasses were up about the same time as those in the other plats. This amount of seed made a very thick mat of grass and kept the weeds back very thoroughly.

The Orchard grass was light in color and did well until the last of July, when it was considerably affected by the dry weather. In low places and in spots where thinly seeded it was not so badly affected.

The Alfalfa was dark green, and until affected by the drought in July, when it turned yellow, made a fair growth; although some of it seemed dead, the roots were not affected, and later in the season it revived and made a fair growth.

Red Top was thick and grew well. In color it resembled the Blue grass. It suffered from the drought; but a little of it was headed July 23.

The mixture of grasses was less affected by the dry weather than any of the others. The Alsike and Red clover were from four to six inches high July 23. The Orchard grass larger in low places. The White clover small but very thick, and the Red Top was in blossom.

The Alfalfa or Lucerne feeds mainly from the subsoil, and for this reason many fail to obtain as good results with it as they look for. It thrives best on old soil, that which has received deep, thorough tillage for some years. Another year of trial will enable us to speak with more definiteness of the value of these clovers and grasses.

In conclusion, I mention with sincere appreciation the value and aid rendered by my assistant, Alice A. Johnson, in the preparation of this bulletin.

We send it out with the hope that many farmers in our Peninsula State may be induced by the experiences herein narrated to build and fill silos the coming summer, and may glean from the results of the experiments recorded some lessons of real practical service to them.

SAMUEL JOHNSON,
Prof. of Agriculture.

AGRICULTURAL COLLEGE, MICH.,
April 10, 1889.

NO. 48. HORTICULTURAL DEPARTMENT.

1. POTATOES.
2. KALE.
3. EXPERIMENTS WITH SQUASHES.
4. TOMATOES.

The work in this department since it came into the charge of the writer on the 16th of August, has been confined to the closing up for the year of the work undertaken by his predecessor.

The frosts during the last week in August destroyed the collections of squashes, peppers and egg-plants, while the dry weather so hindered the growth of other crops as to prevent their maturity. The observations made were confined for the most part to the following, viz.: Tomatoes, potatoes, kale, hybridized squashes. Careful notes and weights were taken; they were also photographed and seeds saved for next year's use.

I. POTATOES.

The tests of potatoes were confined almost entirely to seedlings that were sent here for trial, many of which are to be placed on the market next spring. Most of them were planted in a very light soil, where they were badly injured by the drought. As a rule only one tuber of a kind was used, and these, cut to one eye pieces, were planted one foot apart, with three feet between the rows.

COY'S SEEDLING No. 88.—(Now named Burpee's Superior.)—From W. Atlee Burpee & Co., Philadelphia, Pa. (Fig. 1, Plate 1.)

One tuber, cut to thirteen pieces, yielded 17 pounds 1 ounce, or at the rate of 318 bushels per acre. Tubers all marketable and very even in size; very smooth and regular with ends abruptly rounded. Eyes few and near the surface. Season, medium. In quality, one of the very best. Flesh white and mealy when cooked. The most productive and promising potato grown the past year.

EARLY OXFORD.—From J. J. H. Gregory, Marblehead, Mass. (Fig. 2, Plate 1.)

One tuber, cut into 13 pieces, yielded 13 pounds 1½ ounces, all of which were merchantable. In shape, somewhat elongated but quite smooth and regular. Eyes few and shallow; skin pinkish white. Quality is excellent. It seems to be a good keeper, and as an early variety is well worthy of trial.

RURAL NEW YORKER NO. 2.—From J. M. Thorburn & Co., New York City. (Fig. 3, Plate 1.)

One tuber furnished 12 one eye pieces and yielded 11 pounds 3 ounces, all of good size. In form, nearly as broad as long and flattened. Skin white; eyes few and inconspicuous. Generally very smooth and regular, although an occasional prong manifests itself. Flesh very white and mealy when cooked. This potato is quite productive and is an extremely valuable variety. Had it been grown under better conditions it might have headed the list. Well worth planting.

NEW QUEEN.—From J. J. H. Gregory, Marblehead, Mass. (Fig. 4, Plate 1.)

One tuber furnished 12 single eye pieces and yielded 9 pounds 8 ounces. It is said to be a seedling of the Beauty of Hebron, and in general appearance it resembles that variety. Gregory, in his catalogue, figures the tubers as being much more slender than they are with us. Eyes large, but few in number, and not deep. A fine looking potato and of excellent quality, but it did not prove very productive here, although others speak of it as a "wonderful cropper."

JUNE EATING.—From Thos. Crane, Fort Atkinson, Wis.

Twenty-four single eyes yielded 22 pounds 10 ounces of merchantable tubers with no small ones. Tubers elongated and nearly cylindrical, with the ends evenly rounded. Eyes large but not sunken. Quite smooth and regular. A very promising early variety.

EXTRA KEEPER.—From Thos. Crane, Fort Atkinson, Wis.

Twenty-four pieces yielded 8½ pounds of medium sized potatoes. In shape nearly round, somewhat flattened, skin smooth and pinkish white in color. Eyes not conspicuous; season late. Apparently a good keeper, but its trial here shows that it is a light cropper upon light soils. Its appearance would indicate that it is better adapted to rich, heavy soils, and there it may prove productive.

SEEDLING NO. 38.—From Colorado Agricultural College, Fort Collins.

Several seedlings were sent here for trial by Prof. Jas. Cassidy, but this one only seems valuable. Thirty-six hills yielded twenty-four pounds. Slightly elongated and flattened. Skin light pink and eyes at the surface.

DAKOTA SEEDLING.—From J. A. Everitt & Co., Indianapolis, Ind.

One tuber cut to twelve pieces produced two pounds and five ounces of potatoes, none of which were marketable. In shape and color the product resembles the original tuber, but the size and yield are very small compared with what was expected from the appearance of the tuber received from Everitt & Co., as that was a large and fine looking potato.

Several varieties were planted upon a very poor soil east of the apple orchard and were so nearly a failure that no record was kept of the weights.

While some of the varieties did not return the seed, others gave a very fair crop under the circumstances, and may be mentioned here as worthy of trial.

Summit.—Tubers of good shape, medium size, with quite large eyes at the surface.

Thorburn.—Tubers regular, smooth, eyes small, of excellent quality, and under good conditions an early and productive variety.

Sutton.—Tubers of good size, skin red and with eyes well marked. It has a tendency to become constricted toward one end, forming a sort of neck.

PRINGLE'S HYBRIDIZED POTATOES.

In the spring of 1887, packets of seeds under the above name were received from the Department of Agriculture. The seeds were planted and the resulting tubers were divided into six sorts, according to their shape and color. These were planted in the spring of 1888, and from the product the following notes were taken:

No. 1.—Tubers long and red. Yield variable, some hills producing no tubers of marketable size, while from others several large tubers were obtained. Often slender, curved, or with one end prolonged into a neck. Many tubers, however, are quite symmetrical, and it is possible that another year's selections will furnish a valuable variety. Season late. A good keeper and of fair quality.

These seedlings were sent to a number of persons in different parts of the State that they might be tested under various conditions, and the following are some of the reports from those who tried seedling No. 1:

A. G. Gulley, South Haven: Ten tubers, cut to three-eye pieces, weighing 1 pound 6 ounces, yielded 61 pounds of fair potatoes.

D. S. Lincoln, Big Rapids: Twelve tubers, weighing 1 pound 6 ounces, produced 38 pounds, of which about half were merchantable. It is of fair quality and quite productive, but its color and shape are against it.

No. 2.—Round and red. Tubers more even in size; none very large, but with more of a marketable size than were furnished by No. 1. Eyes quite deep; quality good. It may prove valuable, especially upon a heavy soil. Season very late.

Report of F. E. Skeels, Grand Rapids: Planted 15 tubers of Pringle's No. 2, weighing 1½ pounds. Harvested 61 pounds, of which 24½ were merchantable. Size fair; quality good.

George Skene, Port Austin: Eleven tubers, No. 2, weighing 1 pound 5 ounces, yielding 10 pounds 4 ounces. Quality not good.

PLATE I.

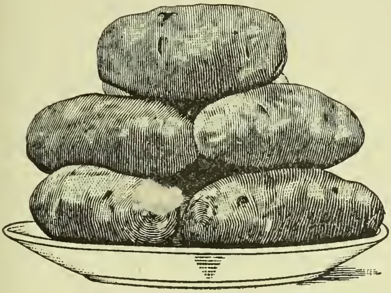


FIG. 1.—Burpee's Superior.

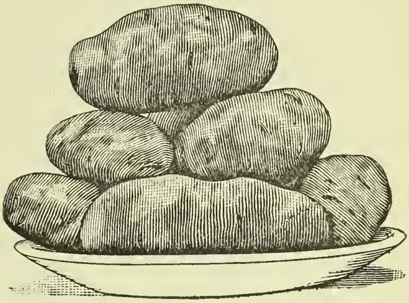


FIG. 2.—Early Oxford.

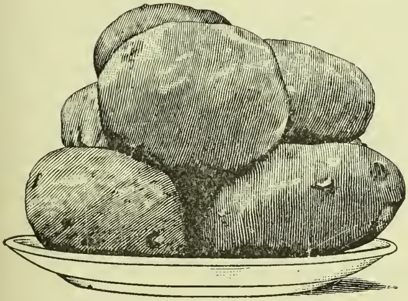


FIG. 3.—Rural New Yorker, No. 2.

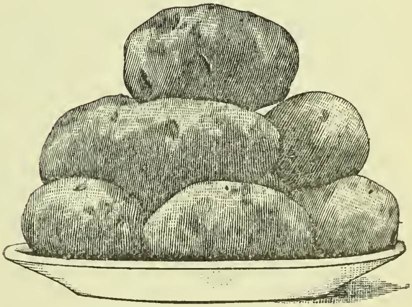


FIG. 4.—New Queen.

Nos. 3 and 4.—Color purple. Worthless.

No. 5.—Long and white. Several types were noticeable among these seedlings, the best being flattened, very smooth. Eyes even with the surface and hardly noticeable. Many of them perfect in form and of a large size. Flesh white and of the very best quality.

Only one report was received. George Skene reported from 1 pound and 6 ounces a product of 8 pounds and 13 ounces. Growth of vines strong. Tubers larger than the seed.

Thos. Brown, Grandville, Michigan: The vines were badly injured by the beetles, but No. 5 shows itself to be a good potato, while No. 6 is better, yielding equal to Beauty of Hebron.

No. 6.—Round and white. The types of this group were of good size and something the shape of a short, thick yam. Quite watery and of poor quality. This form also appeared occasionally in No. 5, while the bulk of No. 6 were long and flattened, and could very properly be classed in No. 5.

D. S. Lincoln, Big Rapids, reports: Nine tubers weighing 1 pound and 13 ounces produced 21 pounds, of which 9½ were merchantable.

II. KALE.

(Brassica oleracea acephala.)

A plant of the cabbage family extensively grown in Europe for the table, and as food for cattle. It produces a crown of leaves but does not form a head. As a vegetable it dates back more than two thousand years to the early days of Rome. It was also cultivated by the ancient Greeks.

Kales require the same care as cabbages, and can be used for the same purposes. The table varieties are preferred to cabbages, as they are hardier, and are also milder in flavor. They may be left in the field when the temperature does not get below zero, and can be used at any time during the winter.

A dwarf variety is often sown in the fall, wintered over the same as spinach and used for greens under the name of "sprouts" or "German greens." As food for stock the coarser varieties are much esteemed in France, but in this country, where corn and roots can be so cheaply grown, it will never be valued as an article of fodder.

Seeds of the following varieties were obtained from Vilmorin, Paris, and were planted and cared for the same as early cabbages. The French names given are those under which they were purchased:

DWARF GREEN CURLED KALE. CANADA KALE. (*Chou Frisé Vert á Pied Court.*)

Stem short and stout. The leaves, which rest upon the ground, are quite narrow and deeply lobed, and average fifteen inches in length. The sides and ends of the leaves are much curled and are often rolled underneath. The blades are green, while the veins are white in color. This variety is quite hardy and with slight protection will pass the winter out of doors. One of the best for culinary purposes.

TALL GREEN CURLED KALE. TALL SCOTCH KALE. (*Chou Frisé Vert Grand.*)

A tall growing variety differing from the above form principally in length of stem and in the leaves being more plume like. Stem stout and straight, three or four feet high.

DWARF RED CURLED KALE. (*Chou Frisé Rouge á Pied Court.*) Fig. 5, Plate II.

Differs from Dwarf Green Kale only in having leaves with red veins and reddish green veins.

TALL RED CURLED KALE. (*Chou Rouge Frisé Grand.*)

Like the Dwarf Red except that it has a long stem like the Tall Green.

CUT LEAVED CURLED KALE. (*Chou Frisé Lacinié Panaché.*)

Similar to the Dwarf Red in color, but is slightly taller, being one and one-half to two feet in height. The edges of the leaves are very finely divided and the midribs and veins are marked with bright red.

CURLED WHITE VARIEGATED KALE. (*Chou Frisé Panaché Blanc.*)

Two and one-half feet high. Leafstalks and veins of a clear white color, which often spreads over half the blades of the newer leaves.

CURLED RED VARIEGATED KALE. (*Chou Frisé Panaché Rouge.*)

Differs from the last only in having red or pink midribs and veins, while the blades of the leaves are of a reddish green.

DOUBLE CURLED HALF DWARF GREEN KALE. (*Chou Extra Frisé Demi Nain Vert.*)

Much curled. Plant erect, two feet high. Leaves green, edges finely cut and moss curled. An excellent variety either for cooking or garnishing.

CURLED WINTER MOSBACH KALE. (*Chou Frisé d'Hiver de Mosbach.*)

Very much curled. Veins well marked with white. Borders of the leaves often of a light yellow.

CURLED WINTER KALE OF HALLÉ. (*Chou Frisé d'Hiver de la Hallé.*)

Much like the last, except that it is coarser and less finely curled.

RED MARROW KALE. (*Chou Moellier Rouge.*)

Three and one-half feet high, slim, stout, often swollen to three and four inches in diameter, and filled with a cellular pith; leaves large, lobed at the base and scattered along the stem. The plants are rather tender; largely used in France for stock feeding.

WHITE MARROW KALE. (*Chou Moellier Blanc.*)

Differs from the last in having white stalks and veins.

Plate II.

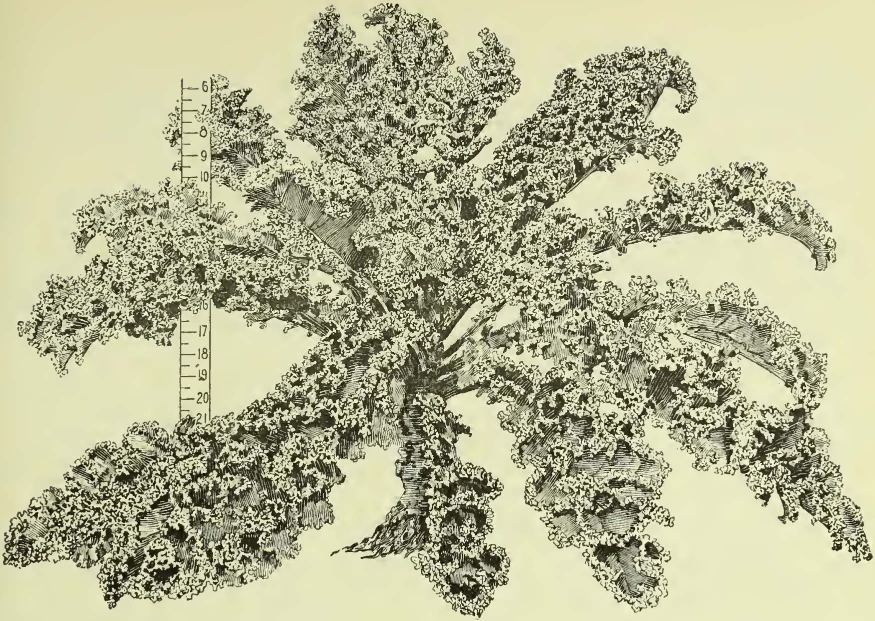


Fig. 5.—Dwarf Red Curled Kale.

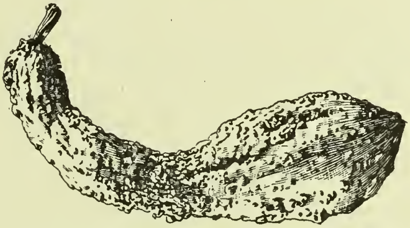
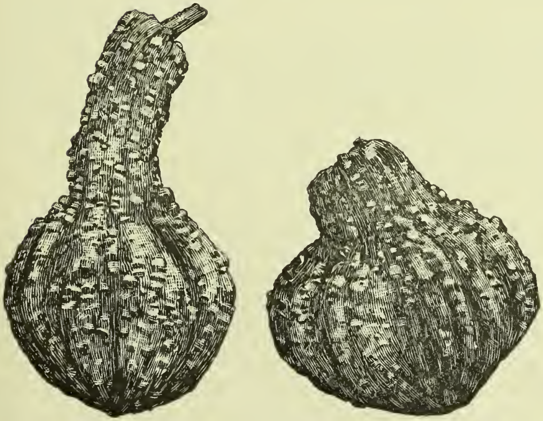


Fig. 6.—Fruit resulting from Crookneck × Bush Scallop.



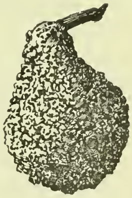


Fig. 8.—Squash No. 8 (a), 1887.

Fig. 7.—Produced from seeds taken from squash shown in Fig. 6.

RED FLANDERS KALE. (*Chou Caulet de Flanders.*)

One of the hardiest varieties; leaves rather small for this class, with the borders sinuate and undulating. Stems and vines light red, and the former becoming slightly branching by throwing up suckers from the axils of the leaves.

RED JERSEY CAVALIER KALE. (*Chou Cavalier Rouge de l'Artois.*)

Plants quite large and tree-like in appearance. The variety owes its name of *Cavalier* to the fact that when full grown it is as high as a man on horseback. The stem is straight, comparatively slender, and without axillary shoots; in color, the stem and leaf stalks are pinkish red.

ANGERS KALE. (*Chou Branchu de Poiton.*)

Not quite as tall as the Flanders Kale, which it resembles in appearance, except that it has white leaf veins. Leaves generally larger and with longer and more slender stalks than that variety.

THOUSAND HEADED KALE. (*Chou Mille Têtes.*)

In habit of growth this is similar to the Angers Kale, but it is more branching, while the leaves are quite large and more numerous. The least hardy of any of the varieties.

PALM KALE. (*Chou Palmier.*)

Leaves narrow, dark green in color, much crinkled, and in shape and size resembling tobacco leaves. The first year it only attains the height of two or three feet, but when three years old it is said to be seven or eight feet high. It is only valued as an ornament.

COW CABBAGE. (*Chou Cavalier Chou a Vache.*)

A forage kale, intermediate between Chou Branchu du Poiton and Mille Têtes.

LARGE LEAVED STOCK KALE. (*Chou Fourrager de la Sarthe, a tres Large Feuille.*)

Stem stout; leaves very large and broad, much like the lower leaves of cabbage. The plants reach a height of two and one-half feet the first year and furnish a large amount of fodder for stock.

III. CROSS FERTILIZATION OF SQUASHES.

The question as to whether the effect of a cross is confined to the ovules (seeds) the first year, or extends to the ovary and receptacle, has earnest advocates upon both sides.

Hoping to learn something regarding the matter, in 1887 Prof. Bailey artificially fertilized the pistils of Yellow Crookneck squash vines with pollen from the stamens of White Bush plants. From these plants four fruits were obtained, which did not differ in appearance from true Crooknecks (Fig. 6, Plate II), indicating that the effect in squashes, at least, was confined to the seeds.

Seeds from two of these fruits were planted last spring, and the fruits produced showed conclusive evidence of their parentage. They were in all cases white like the male parent, but were also covered with warts, which are so noticeable in the Crooknecks. While some of them had necks that were slightly developed, most of them were flattened and with deep scallops similar to those of the White Bush. (Fig. 7, Plate II.) The effect of the White Bush seemed most potent. Some of the seeds were planted on muck and others upon sandy soil. The effect of the soil upon the character of the fruit was quite noticeable, as the fruit grown upon light soil had much shallower creases, and fewer warts than those grown upon muck.

Another experiment has given some very interesting results. Seeds of Crooknecks, Bush, and other varieties of squashes were planted near together and allowed to cross fertilize but no effect of crossing could be detected in the fruit as no effect was noticeable in the fruits upon any one vine. Twenty-three typical fruits were selected, photographed, and the seeds removed. Last spring the seeds were planted, and, as might be expected, there was great variation in the fruits, upon different vines, although the fruits upon any one vine were identical. To show the effect of the cross, the notes upon one of the squashes are here inserted.

Squash No. 8 (a)—Fruit from Crookneck seeds planted in the spring of 1887. Length 5½ inches. greater diameter 4½ inches, very warty, irregularly ridged. (Fig. 8, Plate II.)

Squash No. 8 (b)—Seeds were selected from the above squash No. 8 (a), planted in the spring of 1888, and the following fruits (Fig. 9, Plate III) were raised from different vines.

1. Orange, very warty, and irregularly ridged.
2. Dark green, with a few yellow spots near blossom end, warts numerous but small, not ridged.
3. Dark green, a few yellowish spots on one side, nearly smooth, warts few and small, ridges inconspicuous.
4. Greenish white. with dark green stripes between scallops running from stem to blossom. The body color spotted with the same shade of dark green, a few small warts, regularly scalloped. Flattened.
5. Cream color, warts few, regularly and deeply scalloped. Flattened like Bush scallop.
6. Cream color, very warty, irregularly and but slightly scalloped.

The differences in the other twenty-two cases were nearly as marked as in those mentioned. And, especially as the results coincide with those obtained by others, the only conclusion that can be reached is that, under normal conditions, the effect of a cross upon the squash is confined to the seeds. This test with one plant is of course not sufficient to warrant the statement that the same rule holds true for all plants, but, although many cases are instanced where the pollen affects the receptacle, yet no investigators, while working upon this subject, have been able to produce fruits in which the ovary walls or receptacle were affected by the pollen used.

IV. TOMATOES.

In the test of tomatoes the same course was pursued as last year, and with the exception of Nos. 170 to 177 the seed used was saved by the department, so that from most of the varieties three crops of fruit have been secured since the seed was originally obtained from the seedsmen.

PLATE III.

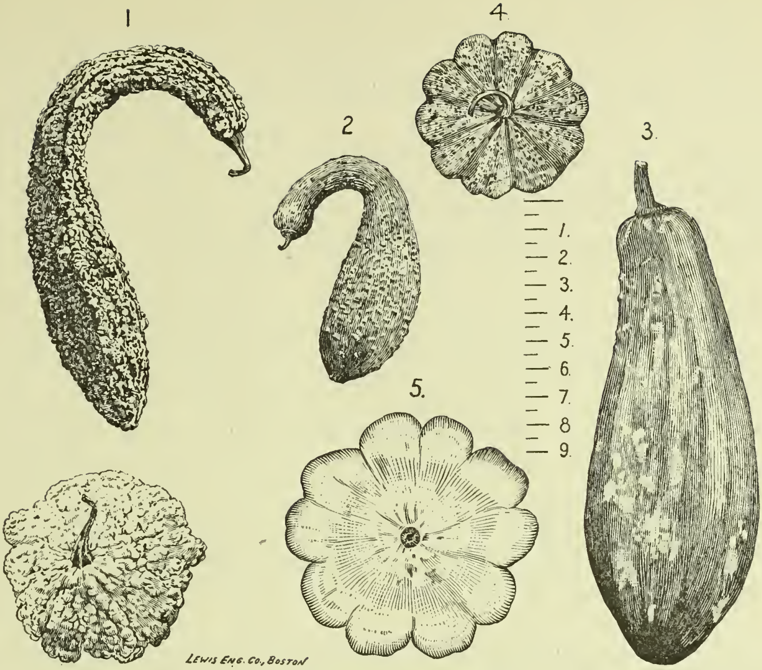


FIG. 9.—Squash No. 8 (b), 1888.

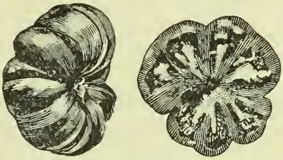


FIG. 10.—Early Dwarf Red.

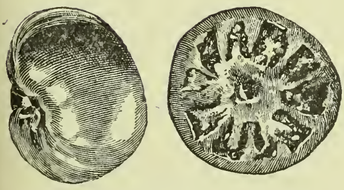


FIG. 11.—Extra Early Cluster.

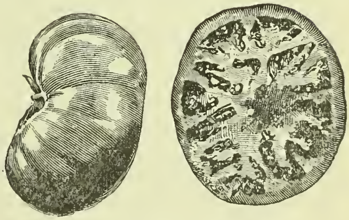


FIG. 12.—Queen.

The collection embraces all of the leading varieties advertised by the dealers, and, as many of them were offered under different names or as special strains, it contained one hundred and forty-eight varieties. This was still further increased by the fact that fifty-two of these varieties were also grown from seeds saved from the first ripe fruits, making a total of two hundred varieties or numbers.

The seeds were sown in the forcing house on the 15th of March, and a record was made of the per cent of germination. After being transplanted, six plants of each kind were placed in the garden as soon as danger of frost was over. They were planted five feet apart each way and, despite the dry weather, soon covered the ground, making it difficult to gather the fruit without injuring the vines.

The first ripe fruits were noticed on the 15th of August, and the first picking was made on the 17th. The ripe fruits of each variety were counted and weighed, and the gathering was repeated, at frequent intervals, until the 15th of September, when all of the fruits upon the vines were picked, weighed and counted. The plants were also pulled and weighed.

Typical fruits were selected and photographed and the seeds which they contained were saved for next year's planting.

In the following synopsis of the varieties an attempt has been made to group together not only the varieties which are undoubted synonyms, but all those whose habit of growth, time of ripening, productiveness, and the size, color, and other characters of the fruits do not offer ready means of separation.

Although the number of varieties is not reduced by this, the difficulty of selecting varieties for planting is greatly decreased, as the gardener need only consider the groups instead of taking into account the dozen or more varieties of which the group may be made up.

CONCLUSIONS.

The following resumé is given for the benefit of those who do not have the time for an extended study of the table.

Varieties Recommended for Planting:

For pickling and preserving, any of the pear and plum varieties will be found desirable. The Green Gage and White Apple also answer well for this purpose. Of the yellow, apple shaped varieties Jaune Grosse Lisse Vil. proved most satisfactory. Golden Queen or Yellow Jefferson will also be found desirable.

The angular sorts are often recommended on account of their earliness, but, although many of them reach a large size and are very productive, several of the smooth sorts possess these characteristics in an equal degree, and are therefore preferable. If any of the angular sorts are to be grown, Extra Early or Cluster, Lan.,* will perhaps give best satisfaction.

For ordinary table and cooking purposes the chief dependence should be placed on the apple shaped sorts. A selection made up of the Advance or Hathaway's Excelsior, for early, and of almost any found in the Cardinal, Paragon, or Perfection groups, for the main crop, will answer every purpose either for home use or market.

---

* Lan. Neu., etc., after the name of a variety, merely indicates that the seed was obtained from Landreth, Neuman, etc.

All of the new varieties grown for the first time this year seem valuable and well worthy of cultivation.

Of these varieties Glen Cove, *Burpee*, Bay State, *Rawson*, Volunteer, *Hallock*, and Americus Hybrid, *Faust*, are much alike and are fine, large tomatoes.

The Americus averages a trifle larger than the others, and was the earliest; Volunteer was a little later but was more productive.

Among the older varieties the Ignotum deserves special mention. This tomato was obtained as a sport from Eiformige Dauer. This year it exhibited some tendency to revert, but it furnished us the largest and finest fruits we had. They were thick, solid and quite smooth. One of the earliest to ripen, the plants remained vigorous throughout the season, notwithstanding the dry weather, and still bore a number of green fruits when killed by the frost. The variety was tested by quite a number of specialists and without exception they spoke favorably of it. Prof. Goff, of the N. Y. Experiment Station, writes: "Although the fruits were not very uniform, some were as fine as anything in the shape of a tomato I have ever seen; of good size, remarkably solid and perfectly smooth. With a few seasons' selection it will doubtless be unsurpassed."

Mr. A. I. Root, Medina, Ohio, speaks in equally high terms of it.

Effect of Using Seeds from First Ripe Fruits.

Fifty-two varieties were planted in duplicate, six plants being grown from seeds of the first ripe fruits of 1887, and the six adjoining hills from seeds selected some two weeks later.

The result as affecting the individual varieties is shown by the table, those grown from the first ripe fruits being designated "a."

Compiling the weight of the fruits grown from these varieties it was found that the seeds of the first ripe fruits produced at the first picking, 35¾ pounds of ripe fruit, while the other plants gave only 28½ pounds, showing a gain of 7¼ pounds in favor of planting seeds of the first ripe fruits, or 25 per cent.

Examining these figures it was found that the angular sorts, which naturally ripen early, produced 26 9-16 pounds at the first picking from the first ripe fruits, while only 6 11-16 pounds were produced by the late fruits, or only one-fourth as many. With the apple shaped sorts the result was reversed, as the yield was respectively 8 3-16 pounds and 21 7-16 pounds for the seeds from the first and the late ripening fruits, or in other words the first picking of tomatoes of angular varieties gave four times as many fruits from plants grown from seeds of the first ripe fruits as from those selected from the main crop, while with the apple shaped sorts only two-fifths as many were obtained.

SYNOPSIS OF THE VARIETIES GROWN IN 1888.

I. LYCOPERSICUM PIMPINELLIFOLIUM. Dunal.

Plants slender and spreading. Leaflets round ovate, generally obtuse, entire, small.

1. *Currant*. Thorburn. (*Rothe Johannesbeerfruchten*, Neuman.) (Fig. 13, Plate IV.) Fruit two-celled, light red, round, and about half an inch in diameter. Too small to be of any value

PLATE IV.

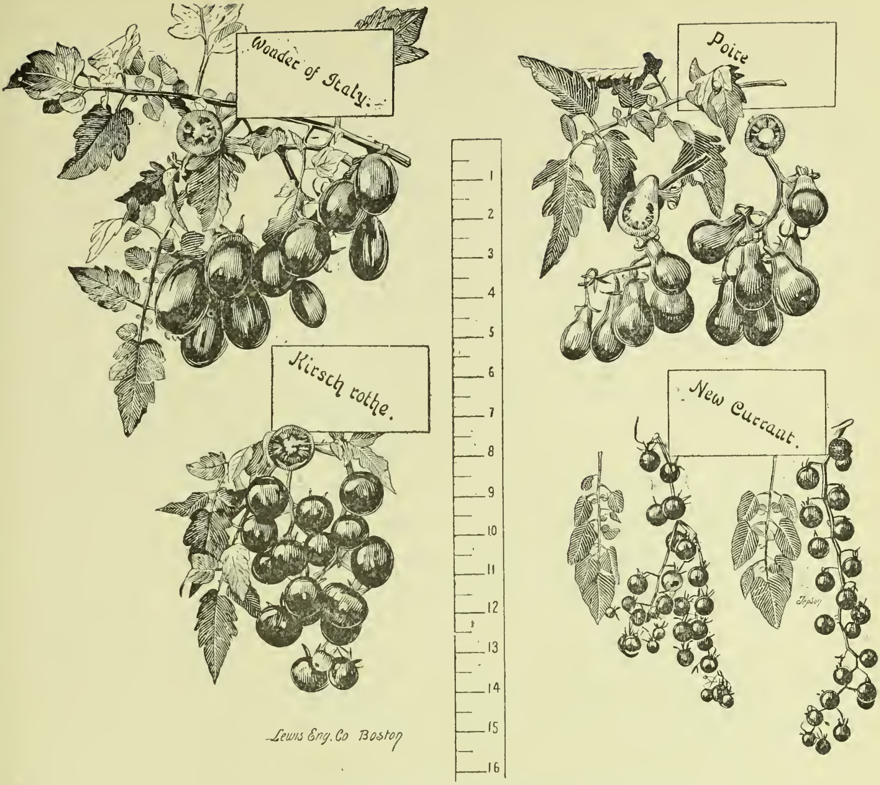


FIG. 13.—Currant, Cherry, Pear, and Plum Tomatoes.

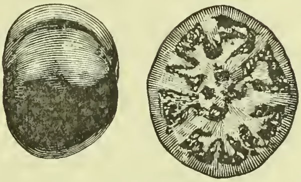


FIG. 14.—Scoville.

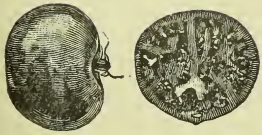


FIG. 15.—Advance.

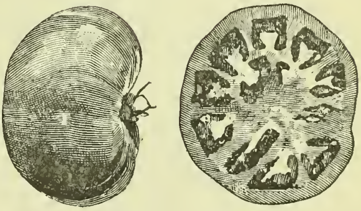


FIG. 16.—Ignotum.

II. LYCOPERSICUM ESCULENTUM.

A. Cerasiforme.—Cherry Tomatoes. Plants slender, recumbent. Fruit round, smooth and two-celled.

2. *Red Cherry,* Henderson. (*Cerise,* Vilmorin; *Kirsch rothe,* Neuman.) (Fig. 13, Plate IV.) Greenish red to dark red. Average size three-fourths of an inch in diameter. The same difference in size was noticeable as appeared this year, the American seed producing fruits only half as large as those obtained from France and Germany. The fruits grown from the latter were often angular and contained three cells. Valuable only for pickles and preserves.
3. *Yellow Cherry,* Thor. (*Gelbe Kirsch,* Neuman.) Differs from Red Cherry in color only.

B. Pyriforme.—Group 1. Pear-shaped. Plants vigorous, with quite large, deeply cut and slightly curled leaves. Fruits pear-shaped, with the necks generally well marked.

4. *Poire,* Vil. (*Queen of Tomatoes,* Dickson.) (Fig. 13, Plate IV.) Fruits average 1¼ inches in length, and ¾ of an inch in diameter at the base. Distinctly pear-shaped, deep red.
5. *Nisbit's Victoria.* Slightly larger than the above, but greatly resembles it. Neck less distinct. Leaves large, but differing from those of Potato Leaf.

Group 2. Oblong Tomatoes.

6. *Wonder of Italy,* Burpee. (*Rothe Birne,* Neuman. *Pear-shaped,* Henderson. *Red Plum,* Hend.) (Fig. 13, Plate IV.) Fruits oblong, occasionally showing a slight neck, 1⅝ inches long by 1¼ inches broad. Generally two-celled, dark red, firm. The only difference in these varieties is that the Wonder of Italy averages slightly larger than the others.
7. *Yellow Plum.* Differs from the last only in color.
8. *King Humbert,* Vilmorin, Neuman, Dickson and Rawson. Fruits of this variety from seeds obtained from Vilmorin were but little larger than the Pear-shaped of Henderson, while those from Neuman, Dickson and Rawson averaged much larger, measuring 2½ inches long by 2 inches broad. Frequently slightly pear-shaped. Dark red, very productive, but the fruits, especially the large ones, are often hollow.
9. *Criterion.* Average fruits 2½ by 2 inches. End abruptly flattened; slightly angular. Fruit resembles Acme in color, generally two-celled, but sometimes contains four or five cells and then measures 3 inches by 1½ deep.

C. Vulgare.—Plants strong and vigorous, foliage coarser and darker than in the last two groups. Fruits flattened or round, and with more than two cells.

Group 1. Fruits more or less angular. Fruits flattened, generally smooth on top, but deeply furrowed and corrugated around the edges and on the under side. Many of the varieties reach a large size and are early in ripening, but most of them are so irregular that they are of little or no value for cultivation.

10. *Orangefield.* Sibley. Fruits slightly corrugated, round or oval, 2½ by 3½ inches deep. Slight red, rather soft.

11. *Eiformige Dauer,* Neu. Fruits small, seldom reaching a diameter of 2 inches, even in size and shape. Angles well marked. Quite firm and a long keeping variety. In color about like Orangefield.
12. *Hundred Days,* Thor. (*Hundert Tagige,* Neu. *Stamfordian,* Dick.) Plants rather small. Fruits measure 2 by 2½ inches, flattened, deeply ribbed, often curved and with a ring at the end. Foliage much curled.
13. *Large Red,* Dick. (*Early Richmond,* Landreth. *Cedar Hill,* Neu. *Franz gross rothe,* Neu.) Fruits and plants larger than the last, but identical in other respects. Dark red, marked slightly with yellow dots. Fruits measure 2½ by 4 inches and 1½ deep.
14. *Precursor*, Nellis. (*Conqueror.* Hend. Neu. *Bermuda Extra Early,* Land. *King of the Earlies,* Ely.) Much more regular and less angular than Large Red. Fruits 3 by 3½ inches, being nearer round than those of the Large Red type. The different strains of Conqueror vary in size and color. Ely's King of the Earlies is apparently a well selected Precursor, fruits even in size, thickly clustered. Although not as early as its introducer claims, its fruits are abundant, of good size and fairly smooth.
15. *Extra Early or Cluster*, Land. (*Jackson,* Dick. *Rouge Grosse,* Vil.) (Fig. 11, Plate III.) The best of the angular varieties, large, even in size and shape, generally 3 or 4 inches in diameter and quite deep. Sometimes distinctly angled, but many of the fruits are nearly as regular as Cardinal.
16. *Turk's Cap.* (*Turkenbund,* Neu.) Plants with slender branches. Fruits small, round, deeply ribbed, with a crown of irregular cells upon the center of the apex. Worthless.

The fruits in the next four groups have their leaves much more curled than the above kinds.

17. *Early Dwarf Red,* Dick. (*Rouge naine hative,* Vil. *Frühe rothe zwerg,* Neu. *Hubbard's Curled Leaf,* Nellis. *Kransblätter,* Neu. *Rouge gross hative,* Vil.) (Fig. 12) Fruits flattened, smaller than Large Red, 2½ to 3 inches long by 1 inch deep. All quite variable in form.
18. *Tom Thumb,* Rawson. Plants small. Leaves much curled. Fruits much like those of Hundred Days and Early Dwarf Red, but are smaller and more irregular.
19. *Keye's Early Prolific,* Neu. Fruit larger and smoother than Tom Thumb. Leaves quite large and much curled.
20. *Gestreifte,* (Striped.) Neu. Similar to Early Dwarf red except that the red fruits are striped and splashed with orange.

Group 2. The apple-shaped sorts:

* Fruit yellow or yellowish white.

21. *Green Gage,* Hend. Neu. Dick. Fruit small, seldom exceeding 1½ inches in diameter, deep yellow, nearly spherical from Henderson, while from Dickson and Neuman, as last year, it gave fruits much larger in size, some of them reaching two inches in diameter.

22. *Large Yellow Improved,* Thorburn. Larger than any of the forms of Green Gage, averaging about 2½ inches in diameter, somewhat flattened.

23. *New White Apple,* Thor. (*Snowball,* Nellis. *Apfel Weisser,* Neu.) Fruit spherical 1½ inches in diameter, slightly flattened as grown from Prussian seeds. Rather soft, and nearly white in color.

24. *Golden Queen,* Rawson. (*Yellow Jefferson,* Leonard. *Sunset,* Tillinghast.) Larger and lighter in color than Large Yellow, often becoming slightly orange at the apex. Two and one-half inches in diameter, flattened, and sometimes slightly oblong, generally regular but occasionally corrugated.

25. *Yellow Victor,* Gregory. Dark yellow, much flattened, 3 inches in diameter. Often angular and irregular.

26. *Jaune Grosse lissè,* Vil. Large, smooth and deep, 3 inches in diameter. Color much like Yellow Victor, often becoming quite dark. The best of the large yellow varieties.

27. *Golden Trophy,* Rawson. In shape resembling the Red Trophy, but somewhat smaller; color light yellow, tinged with red.

** Fruit red.

28. *Little Gem,* small, flattened, 2 inches by 1¼ deep, regular and smooth.

29. *Cook's Favorite,* Greg. Fruit smooth, regular and round, nearly spherical, considerably larger than Little Gem, which it closely resembles in other respects. *Cook's Favorite,* Neuman, was nearly as angular as Early Dwarf Red. Evidently untrue.

30. *Boston Market,* Raw. (*Faultless,* Greg. *Fulton Market,* Greg., Neu. *Gen. Grant,* Hend., Neu. *Alpha,* Thor. *Canada Victor,* Hen.) Quite variable in form, some being smooth and regular, while others are angular and curved. Average fruits about 3 inches across by 1½ inches deep. Boston Market and Faultless are sometimes considerably marked with bronze. The above varieties very nearly approach Conqueror of the angular class.

31. *New York Market,* Nellis. Large, smoother and thicker, but less productive and later than Boston Market. Fruits are generally quite regular and measure 3½ inches across by 2 inches deep.

32. *Trophy,* Dickson, Neuman. (*Extra Selected Trophy.* Hend. *Arlington,* Greg. *Hackwood Park Prolific,* Dick.) The best specimens measured over 4 inches in breadth with a depth of nearly 2½, the larger ones becoming oblong, curved and sometimes quite irregular. Extra Selected Trophy seems to have a larger proportion of fruits, regular and symmetrical.

33. *Bronze Foliage Trophy,* Thorburn. Fruit similar to Trophy but nearly two weeks later. Stem and leaf veins marked with dull purple. Leaves darker green than those of Trophy.

34. *Cardinal,* Hend., Thor., Neu., Dick., Root. (*Queen,* Nellis. (Fig. 12, Plate III.) *Prize Belle,* Buist. *Market Champion,* Ford. *Champion,* Neu. *Red Valencia Cluster,* Thor.)

Fruits large, four inches across by nearly two inches deep, somewhat flattened, and sometimes quite angular. Cavity broad and deeply furrowed. Light red with small yellow or golden spots.

35. *Perfection*, Hend. (*Optimus*, Ferry. *Scoville*, Perry. (Fig. 14, Plate IV.) *Autocrat*, Sibley. *Glatte Amerikan*, Neu.) Fruits medium to large, nearly spherical, smooth and regular. Cavity very small, and generally without furrows. Dark red.

36. *Mayflower*, Hend., Root, Neuman. (*Paragon*, Hend., Neu. *Ignotum*, College. (Fig. 16, Plate IV.) *Puritan*, Rawson. *Glen Cove*, Burpee. *Emery*, Rawson. *Bay State*, B. L. Bragg. *Volunteer*, V. H. Hallock. *New Red Apple*, Greg. *Livingston's Favorite*, Sib., Hend., Dick. *Americus Hybrid*, Faust. *New Jersey*, Land.) Less angular than those of the Cardinal class but more irregular, flattened, and larger than the Perfection.

37. *Hathaway's Excelsior*, Hend., Root, Dick., Vil. Fruits medium to small, seldom reaching 3 inches in diameter, quite deep, the smaller ones being nearly spherical. Light red, smooth and regular. One of the best early varieties.

38. *Advance*. (Extra Early Advance.) Ford, Burpee. (Fig. 15, Plate IV.) Fruits differ from Hathaway only in being smaller and earlier. Plants generally smaller but very productive.

*** Fruits pink or purple.

39. *Peach*, Land. Fruit spherical or slightly elongated. One and one-half inches in diameter; smooth and regular; of a pinkish red color, resembling a peach.

40. *Acme*, Dick., Vil., Neu., Liv. (*Rochester*, Sib. *Rochester Favorite*, *Livingston's Beauty*, Liv. *Climax*, Raw. *Hovey*, Thor.) Fruits generally large and smooth, resembling Perfection in shape, but of a pinkish purple color. An excellent variety for home use or local market, but its thin skin makes it too tender for shipment. Beauty is perhaps less flattened than Acme.

D. GRANDIFOLIUM. Tomatoes with large leaves. Plants large, vigorous, in habit like those of the last class. Leaves few and large, nearly entire.

41. *Mikado*, Hend. (Turner's Hybrid.) Fruit very large, flattened, often oblong, cavity deep, often much furrowed, basin generally distorted in the larger fruits. Quite early, and averaging the largest of any tomato grown. Color of Acme.

42. *Potato Leaf*, Mills, Livingston. In plant much like Mikado, but the fruit is much more regular and more flattened.

E. VALIDUM. Upright or Tree Tomatoes. Stems short and stout, being self-sustaining. Leaves dark green, much curled and netted.

43. *New French Upright*, Thor. (*Grenier mit aufrechten stämme*, Neu. *Rouge à tige roide de Laye*, Vil. Fruits large and quite late, generally very irregular, basin deeply furrowed,

and cavity often fissured, with projecting cells. Not productive.

42. *Station,* N. Y. Ex. Station. Derived from a cross of Alpha on French Upright. Plant much like the last, generally smaller. Fruit smaller and generally quite regular, but without value.

43. *Dwarf Champion,* Hend. A half dwarf variety. Branches short and stout, but not quite self-supporting. Leaves quite dark and much curled, something like those of the Upright varieties. Fruits resemble Acme in color, but are considerably smaller, quite smooth and with firm flesh. Yield (12 pounds per plant) considerably under the average; time of ripening medium.

Aside from the smoothness and quality of the fruit, about the only good things that can be said of this variety, *judging from one year's trial,* are that owing to its dwarf habits the plants can be planted much closer than other varieties, and that trellising may better be dispensed with.

As indicated by the opening sentence of the bulletin, this work was begun and carried on for the first of the season by Prof. Bailey, to whom credit should be given. The notes upon the squash, the comparative table, and the photographs of the different varieties, were made by my assistant, Mr. C. S. Crandall, to whom I am indebted for assistance in carrying out the details of the work.

L. R. TAFT,
Prof. of Horticulture and
Landscape Gardening.

MICHIGAN AGRICULTURAL COLLEGE,
April 1, 1889.

COMPARATIVE TABLE.

Name and Number of Variety. (Concluded on next page.)		Aug. 17.		Aug. 20.		Aug. 22.		Aug. 25.		Aug. 27.		Aug. 30.		Sept. 3.		Sept. 4.		Sept. 6.		Sept. 8.	
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.
Tom Thumb, Rawson ---No.	1	------	------	----	------	------	------	2	4	------	------	6	12	28	84	----	----	63	142	------	------
" " "	1 a*	6	13	1	1½	3	3	2	4	------	------	36	68	49	90½	----	----	72	143	------	------
Hubbard's Curled Leaf, Nellis	2	------	------	----	------	1	1	5	11	------	------	76	199	29	83	----	----	52	131½	------	------
" " " "	2 a	4	7½	1	½	2	2	6	14	------	------	29	88	34	103	----	----	74	188	------	------
Krausblatter, Neuman	3 a	9	21	7	16	1	2	12	27	------	------	58	153	90	242	----	----	116	330	------	------
Precursor, Nellis	4	------	------	----	------	------	------	3	6	------	------	27	109	34	178½	----	----	47	204	------	------
" "	4 a	2	5	----	------	2	6	4	10	------	------	16	53	37	165½	----	----	67	258	------	------
Orangefield, Sibley	5 a	1	2	1	2	2	5	19	58	------	------	59	222	84	352½	----	----	------	------	108	397
Hundred Day, Thorburn	6	------	------	1	3½	2	4	9	21	------	------	29	73	51	120½	----	----	------	------	120	280
" " "	6 a	13	26	10	25	2	3	24	50	------	------	110	226	146	312	----	----	------	------	255	510
Hundert Tagige, Neuman	7 a	9	12	9	22	3	3	21	36	------	------	94	187	115	235½	----	----	203	369	------	------
Conqueror, Henderson	8 a	3	8	7	15	------	------	21	36	------	------	80	212	129	334½	----	----	128	296	------	------
" Dickson	10	------	------	2	4	------	------	3	9	------	------	33	80	87	242	----	----	77	236	------	------
" "	10 a	9	23	2	7	1	2	8	24	------	------	44	152	127	429	----	----	82	258	------	------
Large Red, Dickson	11	------	------	----	------	------	------	------	------	------	------	13	70	32	150½	----	----	26	116	------	------
" " "	11 a	5	13	2	5	4	8	5	12	------	------	32	100	87	450½	----	----	------	------	90	374
Early Dwarf Red, Dickson	12	4	13	2	7	------	------	1	7	------	------	17	65	53	174	----	----	------	------	56	198
" " " "	12 a	13	26	1	3	1	2	7	12	------	------	33	80	77	192	----	----	------	------	105	254
Early Richmond, Landreth	13	------	------	----	------	------	------	4	17	------	------	15	71	40	220	----	----	------	------	68	317
" " "	13 a	5	15	6	14	9	32	17	65	------	------	65	261	144	637½	----	----	------	------	135	642
Bermuda Extra Early, Landreth	14	5	16	1	3	1	2½	6	21	------	------	45	173	73	292	----	----	111	369	------	------
" " " "	14 a	1	4	1	3	------	------	1	4	------	------	3	13	5	20½	----	----	28	87	------	------
New Jersey, Landreth	15	5	28	1	7	------	------	9	50	------	------	14	28	50	219	----	----	88	337	------	------
" " Thorburn	16	1	7	----	------	1	9	4	15	------	------	4	26	5	36½	----	----	24	150	------	------
Key's Early Prolific, Neuman	17	6	16	1	6	3	7	13	35	18	48	59	137	86	202	----	----	99	240	------	------
" " " "	17 a	24	62	5	10	1	1½	8	22	------	------	66	143	89	232	----	----	113	296	------	------
Turkenbund, Neuman	18	------	------	2	2	1	1	2	2	------	------	37	48	44	75½	----	----	------	------	84	105
" "	18 a	2	3	----	------	1	1	6	8	------	------	22	36	35	37	----	----	------	------	129	160
Boston Market, Rawson	19	------	------	1	4½	1	1	8	29	------	------	32	104	66	242	----	----	------	------	60	292
" " "	19 a	17	41	1	3	2	4	9	21	------	------	62	208	124	414	----	----	------	------	152	533
Fulton Market, Gregory	20	5	13	6	16	5	22	8	27	------	------	75	205	111	350	----	----	------	------	138	468
" " "	20 a	7	18	2	4	10	36	9	32	------	------	63	199	116	338	----	----	------	------	148	413
" " Neuman	21 a	2	9	1	3	11	27	5	14	------	------	46	139	91	322	----	----	------	------	116	357
General Grant, Henderson	22	2	8½	4	14	7	20	24	81	22	78	72	275	112	418	----	----	------	------	76	310
" " "	22 a	4	12	7	23	17	53	24	64	40	107	63	206	71	250	----	----	------	------	67	248
" " Neuman	23 a	12	38	7	19	3	14	10	28	------	------	57	168	76	242	----	----	------	------	114	421
Alpha, Thorburn	24 a	------	------	3	11	4	13	7	24	------	------	43	152	107	414	----	----	------	------	132	526
Faultless, Gregory	25	9	25	2	4	------	------	2	3	------	------	20	50	97	318	----	----	------	------	135	490
" "	25 a	2	6	3	3	------	------	5	19	------	------	15	57	68	318	----	----	------	------	87	374
Arlington, "	26	------	------	----	------	------	------	------	------	------	------	1	4	------	------	5	26	------	------	16	166
Cook's Favorite, Gregory	27 a	3	4	1	2	------	------	4	9	------	------	13	22	40	77½	----	----	------	------	77	237
" " Neuman	28 a	4	7	----	------	2	2½	4	8	------	------	49	96	62	162	----	----	------	------	93	221
New York Market, Nellis	29	------	------	----	------	------	------	------	------	------	------	6	26	16	93	----	----	------	------	19	98½

---

* "a" Grown from first ripe fruits of 1888.

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety.		Sept. 10.		Sept. 12.		Sept. 15.		Sept. 17.		Sept. 18.		Average weight of plants, oz.	Average number of fruits to a plant.	Average weight of fruits on a plant, oz.	Average weight of a fruit in oz.	Ratio of weight of fruit to weight of plant.	Number of days in germinating.	Per cent.
(Concluded from last page.)		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.							
Tom Thumb, Rawson	No. 1	28	74	66	124	480	460					52	168 1-4	225	1.337	4.326	10	48
" " "	1 a	66	126	80	120	735	704					52	175	212 1-6	1.212	4.08	9	76
Hubbard's Curled Leaf, Nellis	2	50	116	56	120	529	792					54 2-3	133	242 1-4	1.821	4.431	10	50
" " " "	2 a	63	154	50	98	601	839					60	144	260 2-3	1.810	4.344	10	36
Krausblatter, Neuman	3 a	104	325	114	252	691	1,032					70 2-3	200 1-3	400	2.	5.66	10	76
Precursor, Nellis	4	47	237	48	216	364	764					76	95	285 3-4	3.	3.76	9	56
" "	4 a	78	343	61	196	572	952					92	139 5-6	331 5-12	2.37	3.602	10	48
Orangefield, Sibley	5 a			60	252	568	800					71 1-3	150 1-3	348 5-12	2.37	4.884	9	68
Hundred Day, Thorburn	6			150	392	762	1,260					45 1-3	187 1-3	359	1.916	7.919	10	92
" " "	6 a			216	464	574	836					48	192 6-7	350 2-7	1.816	7.297	10	56
Hundert Tagige, Neuman	7 a	89	208	59	227½	165	377					45 1-3	127 5-6	279 1-2	2.186	6.165	11	58
Conqueror, Henderson	8 a	53	132	81	128	192	264					53 1-3	115 2-3	237 7-12	2.054	4.454	11	60
" Dickson	10	67	204	69	152	460	950					91 1-5	159 3-5	375 2-5	2.352	4.116	9	82
" "	10 a	48	216	63	180	528	1,163					96 2-3	152	409	2.69	4.231	9	58
Large Red, "	11	41	186	20	92	502	1,352					88 2-3	105 2-3	327 3-4	3.101	3.696	9	52
" " "	11 a			183	600			728	1,164			127 2-3	189 1-3	454 5-12	2.4	3.559	9	80
Early Dwarf Red, Dickson	12			74	180			874	1,208			82	180 1-6	308 2-3	1.713	3.764	9	72
" " " "	12 a			159	312			898	1,040			81 1-3	215 2-3	320 1-6	1.484	3.936	9	48
Early Richmond, Landreth	13			48	240			442	780			60	102 5-6	274 1-6	2.666	4.569	8	60
" " "	13 a			114	520			794	1,167			119 3-7	184 1-7	479 1-14	2.60	4.011	9	76
Bermuda Extra Early, Landreth	14	64	200	124	208½	431	768					79 1-3	143 1-2	342 1-6	2.384	4.313	8	68
" " " "	14 a	62	245	37	136	636	1,079					112	129	265 1-4	2.056	2.368	10	32
New Jersey, Landreth	15	54	269	47	176	455	1,183					42 2-3	120 1-2	382 5-6	3.177	8.973	10	68
" " Thorburn	16	23	168	28	200	550	1,308					142 2-3	106 2-3	319 11-12	3.	2.241	8	70
Key's Early Prolific, Neuman	17	81	217	97	200	714	1,000					99 1-3	196 1-6	351 1-3	1.79	3.537	10	88
" " " "	17 a	88	241	116	260	700	997					112 4-5	242	452 9-10	1.871	4 015	10	20
Turkenbund, Neuman	18			127	136	2,524	1,133½					164	470 1-6	250 1-2	.532	1.527	8	84
" "	18 a			197	176	2,800	1,260					206 2-3	532	280 1-6	.526	1.355	8	92
Boston Market, Rawson	19			166	564			753	1,708			94 2-3	181 1-6	490 3-4	2.708	5.184	9	74
" " "	19 a			186	664					956	1,734	112 6-7	215 4-9	517 3-7	2.4	4.585	10	18
Fulton Market, Gregory	20			91	256			462	764			99 1-3	150 1-6	353 1-2	2.354	3.558	8	66
" " "	20 a			96	240			252	903½			86	117 1-6	363 11-12	3.106	4.231	10	34
" " Neuman	21 a			107	304			378	536			86	126 1-6	285 1-6	2.26	3.315	10	52
General Grant, Henderson	22			87	304			366	412			121 3-5	154 2-5	384 1-10	2.487	3.158	8	44
" " "	22 a			83	260			417	468½			123	132 1-6	281 11-12	2.133	2.292	9	44
" " Neuman	23 a			122	400			400	636½			104 2-3	133 1-2	327 3-4	2.455	3.131	9	68
Alpha, Thorburn	24 a			161	608			292	452			88 2-3	124 5-6	366 2-3	2.937	4.135	9	20
Faultless, Gregory	25			255	845			787	1,282			125	217 5-6	502 5-6	2.308	4.022	8	46
" "	25 a			67	240			284	691½			73 3-5	106 1-5	341 7-10	3.217	4.642	10	42
Arlington, "	26			38	315					212	196	158 2-3	45 1-3	117 5-6	2.6	.742	8	48
Cook's Favorite, Gregory	27 a			146	240					984	955½	113 3-5	253 3-5	309 2-5	1.22	2.723	10	42
" " Neuman	28 a			103	240					285	356	143 2-3	100 1-3	182 1-12	1.814	1.267	10	80
New York Market, Nellis	29			24	128					420	894	163 3-5	97	247 9-10	2.555	1.515	8	68

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded on next page.)		Aug. 17.		Aug. 20.		Aug. 22.		Aug. 25.		Aug. 30.		Aug. 31.		Sept. 3.		Sept. 4.		Sept. 8.		Sept. 12.	
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.
Victor, Neuman	No. 32 a	15	41	1	2½	1	2	10	34	54	174	------	------	72	250	------	------	108	378	95	320
Ex. Selected Trophy, Henderson	35	------	------	------	------	------	------	2	12	8	31	------	------	24	122	------	------	42	214	41	216
Trophy, Dickson	37	------	------	------	------	1	3	2	10	6	28	------	------	36	151	------	------	66	326	42	176
“ Neuman	38	2	7	------	------	------	------	------	------	7	38	------	------	------	------	31	209	37	258	61	460
“ “	38 a	7	25	------	------	4	11	9	23	6	23	------	------	------	------	64	217	71	258	201	605
Read's Island Beauty, Thorburn	40 a	------	------	2	2	7	6	3	3	16	18	------	------	------	------	84	95	95	47	105	116
Bronze Foliage Trophy, “	41	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	8	59	6	40
Queen, Nellis	42	7	25	4	13	9	34	4	13	17	50	------	------	------	------	62	249	78	317	108	392
“ “	42 a	1	5	8	19	3	10	1	5	7	22	------	------	------	------	29	121	43	225	125	764
Cardinal, Henderson	44	4	7	1	1	------	------	------	------	4	19	------	------	------	------	32	123½	45	185	86	342
“ “	44 a	2	5	1	1	1	2½	4	11	4	14½	------	------	------	------	32	118	37	157	141	550
“ Thorburn	46	------	------	------	------	------	------	------	------	------	------	2	2	------	------	3	25	4	20	19	92
“ Neuman	47	------	------	2	4	------	------	------	------	------	------	5	22	------	------	12	54	26	150	99	208
“ Dickson	48 a	2	5	------	------	------	------	1	3	------	------	5	14	------	------	7	32	8	43	211	657
“ Root	49	8	31	3	5	------	------	2	8	------	------	6	33	------	------	11	55½	43	234	87	465
“ “	49 a	8	13	1	6	3	11	1	2	20	43	------	------	------	------	71	163	30	74	100	191
Prize Belle, Buist	50 a	------	------	------	------	7	12½	------	------	10	35	------	------	------	------	38	215	28	158	127	784
Red Valencia Cluster, Thorburn	51	3	11	------	------	3	7	1	4	5	19½	------	------	------	------	32	105	34	166	70	329
“ “ “	51 a	------	------	------	------	------	------	3	12	2	13	------	------	------	------	8	50	11	61	119	417
Livingston's Favorite, Sibley	52 a	9	41	------	------	------	------	------	------	------	------	9	41½	------	------	23	135	82	288	69	364
“ “ Henderson	53	1	6	------	------	1	2	1	2	------	------	24	73½	------	------	34	157	47	202	99	476
“ “ Dickson	54	2	6	------	------	------	------	------	------	------	------	9	39	------	------	9	44	17	94	66	342
Market Champion, Ford	55 a	8	23	------	------	2	8	------	------	------	------	17	63½	------	------	44	141	74	230	114	396
Champion, Neuman	56 a	3	12	1	2	1	4	1	3	------	------	29	167½	------	------	50	306	62	376	136	452
Hathaway's Excelsior, Hend.	58	------	------	------	------	------	------	------	------	------	------	18	65	------	------	57	191	81	206	184	683
“ “ “	58 a	2	2½	------	------	7	18	3	9	------	------	15	38½	------	------	83	241	62	198	71	336
“ “ Root	59 a	20	51	5	16	6	15½	6	18	------	------	40	147½	------	------	84	285	66	200	183	473
“ “ Dickson	60 a	6	20	------	------	------	------	3	9	------	------	15	44	------	------	40	141	49	190	98	330
“ “ Vilmorin	61	2	5	------	------	2	9	1	3	------	------	7	18½	------	------	33	133	24	110	64	236
New Red Apple, Gregory	63	------	------	------	------	1	3	------	------	------	------	13	60	------	------	40	177	27	137	44	199
“ “ “	63 a	5	21	1	5	2	4	1	4	------	------	27	101½	------	------	61	309	41	214	92	485
Advance, Ford	66	36	76	------	------	6	16	13	32	------	------	60	120½	------	------	160	391	88	246	218	616
“ “	66 a	16	35	4	8	2	4	3	9	------	------	30	68	------	------	82	209	------	------	------	------
Extra Early Advance, Burpee	67	11	19	------	------	9	30	15	35	------	------	52	117½	------	------	86	199	160	392	------	------
“ “ “	67 a	3	3	4	8	2	5	14	27	------	------	64	152½	------	------	194	474	13	36	------	------
Perfection, Henderson	68	4	16	------	------	1	3½	1	4	------	------	5	16	------	------	32	111	74	254	------	------
Paragon, Henderson	71	31	83	5	10	6	17	14	45	------	------	48	165½	------	------	75	249	104	306	------	------
“ Neuman	72	7	26	3	13	2	10	1	7	------	------	1	2	------	------	4	26½	11	126	------	------
“ “	72 a	------	------	6	13	------	------	------	------	------	------	4	18½	------	------	1	2	33	126	------	------
Emery, Rawson	73 a	5	14	------	------	------	------	------	------	------	------	------	------	------	------	7	40½	19	129½	------	------
Autocrat, Sibley	74 a	10	39	------	------	4	9	4	16	------	------	21	76½	------	------	37	173	64	318	------	------

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded from last page.)		Sept. 14.		Sept. 15.		Sept. 18.		Sept. 19.		Sept. 20.		Average weight of plants, oz.	Average number of fruits to a plant.	Average weight of fruits on a plant, oz.	Average weight of a fruit in oz.	Ratio of weight of fruit to weight of plant.	Number of days in germinating.	Per cent.
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.							
Victor, Neuman	No. 32 a					314	526					83 1-3	111 2-3	287 11-12	2.578	3,455	13	68
Ex. Selected Trophy, Henderson	35							379	906			118 2-5	99 1-5	300 1-5	3.026	2.535	8	70
Trophy, Dickson	37							353	1,174			127	84 1-3	311 1-3	3.691	2.451	8	64
" Neuman	38							350	1,024			100	81 1-3	332 2-3	4.092	3.326	8	38
" "	38 a							941	1,984			130 1-3	217 1-6	524 1-3	2.414	4.023	10	30
Read's Island Beauty, Thorburn	40 a							815	624			162 1-3	187 5-6	151 5-6	.808	.935	8	44
Bronze Foliage Trophy, "	41							240	732			217 1-2	63 1-2	207 3-4	3 271	.955	9	34
Queen, Nellis	42							578	980			145	144 1-2	345 1-2	2.391	2.382	10	42
" "	42 a							622	1,618½			198 1-3	139 5-6	464 11-12	3.324	2.333	9	32
Cardinal, Henderson	44							824	1,457			179 2-3	166	355 3-4	2.143	1.98	9	44
" "	44 a							923	1,608			279 1-3	190 5-6	411 1-6	2.154	1.471	10	46
" Thorburn	46							157	361½			100	92 1-2	250 1-4	2.705	2.502	8	8
" Neuman	47							722	1,801				144 1-3	373 1-6	2.585		8	30
" Dickson	48 a							1,245	2,494			203 1-2	184 7-8	406	2.196	1.994	10	18
" Root	49							1,034	2,352			150	119 2-5	318 7-20	2.666	2.122	10	66
" "	49 a					300	312					160	267	407 1-2	1.526	2.547	11	4
Prize Belle, Buist	50 a					541	1,096					155 2-3	125 1-6	383 5-12	3.063	2.462	11	28
Red Valencia Cluster, Thorburn	51					415	930					161 1-5	112 3-5	314 3-10	2.791	1.949	8	34
" " "	51 a					395	905					108 2-3	89 2-3	243	2.71	2.236	10	80
Livingston's Favorite, Sibley	52 a					540	1,026½					216	146 2-5	379 1-5	2.59	1.840	10	46
" " Hend.	53							600	1,157½			189 2-3	134 1-2	346	2.572	1.824	8	32
" " Dickson	54							737	1,682			161	140	367 5-7	2.627	2.283	8	84
Market Champion, Ford	55 a							1,329	1,718			183 2-3	264 2-3	429 11-12	1.625	2.34	9	62
Champion, Neuman	56 a							946	3,336			153 9-11	111 8-11	423 1-2	3.79	2.753	10	54
Hathaway's Excelsior, Hend.	58									1,398	1,888	133 1-3	144 5-6	252 3-4	1.745	1.895	9	59
" " "	58 a							668	708			84 2-3	151 5-6	258 1-2	1.702	3.053	10	72
" " Root	59 a							767	908			149 1-3	196 1-6	352 1-3	1.796	2.359	10	51
" " Dickson	60 a							647	905½			180 4-5	171 3-5	327 9-10	1.91	1.813	12	12
" " Vilmorin	61							602	920			181 1-3	122 1-2	239 1-12	1.951	1.318	10	84
New Red Apple, Gregory	63							586	1,196			166 2-3	118 1-2	295 1-3	2.492	1.772	8	59
" " "	63 a									619	810	281 1-3	141 1-2	325 7-12	2.3	1.157	10	52
Advance, Ford	66									630	812	97 1-3	201 5-6	384 5-6	1.906	3.953	8	36
" "	66 a			174	519					1,806	1,954	173 1-3	352 5-6	467 2-3	1.325	2.698	9	64
Extra Early Advance, Burpee	67			67	184					1,871	2,294	101 1-3	252 1-3	363 7-18	1.44	3.586	10	54
" " "	67 a			140	351					835	830	105 3-5	253 4-5	377 3-10	1.486	3.572	17	23
Perfection, Henderson	68			90	318			559	633½			149 1-3	127 2-3	224 1-3	1.757	1.502	7	64
Paragon, Henderson	71	80	247					719	944			156	180 1-3	344 5-12	1.909	2.207	10	30
" Neuman	72	52	416					463	1,316			134 2-3	90 2-3	323 3-4	3.57	2.404	8	72
" "	72 a	93	552					712	1,730			146 2-3	141 1-2	406 5-6	2.875	2.773	11	27
Emery, Rawson	73 a	47	398							615	1,528	165 1-3	115 1-2	351 2-3	3.044	2.127	10	48
Autocrat, Sibley	74 a			80	373					666	1,200	120	147 2-3	367 5-12	2.488	3.061	11	22

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded on next page.)		Aug. 17.		Aug. 20.		Aug. 22.		Aug. 25.		Aug. 27.		Aug. 31.		Sept. 4.		Sept. 5.		Sept. 8.		Sept. 14.	
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.
Mayflower, Henderson	No. 75 a	12	38	......	......	3	7	7	18	......	......	19	72½	27	131	......	......	29	118	......	......
" Root	76 a	9	34	4	16	5	10	4	4½	......	......	45	108½	48	90	......	......	73	230	......	......
" Neuman	77 a	9	12	1	4	2	4	8	28½	......	......	38	93½	63	173	......	......	182	508	......	......
Scovill's Hybrid, Perry '86	78	......	......	......	......	......	......	1	6½	......	......	4	20½	5	39	......	......	30	214	......	......
" " " '87	79	5	18	1	3	......	......	3	10	11	62	32	132	28	141	......	......	27	138	......	......
" " "	79 a	9	37	1	2	4	13	6	23	10	39	25	99	40	172	......	......	45	206	......	......
Rouge grosse, Vilmorin	80	3	16	3	9	2	7	3	18	......	......	17	79	28	81	......	......	73	322	147	490
Rouge grosse hative, Vilmorin	81	15	31	2	4	3	7	3	7	......	......	58	127	77	160	......	......	99	222	93	204
" " " "	82 a	......	......	......	......	......	......	......	......	......	......	3	25	10	69	......	......	38	286	44	302
Rouge naine hative "	83	3	6	4	7	3	7	11	40	......	......	37	121½	98	370	......	......	124	465	182	671
" " " "	83 a	13	34	3	3	5	7	5	9	......	......	63	131	......	......	68	131	107	226	244	516
Frühe rothe zwerg, Neuman	84 a	16	36	......	......	......	......	8	25	......	......	14	32½	......	......	53	172	62	226	204	508
Cedar Hill, "	86	......	......	3	6	3	7	7	28	......	......	58	210½	......	......	91	363	101	408	......	......
" " "	86 a	4	(11)	1	1	1	2	......	......	......	......	21	58	......	......	74	231	112	404	......	......
Gestreifte, "	87	......	......	......	......	1	2	1	3	......	......	4	11½	......	......	19	59	23	23	......	......
Santa Catharina, "	88 a	......	......	......	......	2	8	4	23	......	......	11	52½	......	......	39	153	30	94	......	......
Franz grosse rothe, "	89	1	3	......	......	......	......	9	26	......	......	21	68	......	......	57	204	78	214	120	311
" " " "	89 a	27	71	13	31	9	31	......	......	......	......	38	114	......	......	115	344	133	422	201	628
Glatte Amerikan, "	90 a	21	78	1	2½	11	27	7	20	......	......	26	108	......	......	48	169	50	250	41	194
Mills' Belle, F. B. Mills	91	......	......	......	......	......	......	......	......	......	......	2	11	......	......	12	60	13	78	......	......
Extra Early or Cluster, Landreth	92	......	......	4	9	......	......	12	40	......	......	76	274½	......	......	117	431	65	234	......	......
" " "	92 a	7	39	3	19	4	9	1	2	......	......	11	47	......	......	37	199	66	326	......	......
Peach, Landreth	93	......	......	11	14	......	......	4	6	......	......	......	......	......	......	5	6	39	79	......	......
Stamfordian, Dickson	94 a	10	16	1	5	......	......	4	13	......	......	58	169½	......	......	104	311	100	214	......	......
Hackwood Park Prolific, Dickson	95	......	......	5	6	4	18	1	4	......	......	14	78½	......	......	27	163	30	202	......	......
Jackson's Favorite "	96	1	2½	......	......	......	......	......	......	......	......	15	69½	......	......	14	37	38	158	......	......
Feejee, Neuman	99 a	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	4	3	13	......	......
Rochester Favorite, Gregory	100 a	14	29	5	11	1	2	5	12	......	......	......	......	......	......	49	144	80	290	......	......
" Sibley	101	......	......	......	......	......	......	......	......	......	......	4	17½	......	......	25	195	6	54½	......	......
" "	101 a	......	......	......	......	......	......	......	......	......	......	18	50	......	......	8	57	7	43	......	......
Livingston's Acme, Gregory	103	15	34	4	7	12	33	12	40	......	......	24	101½	......	......	68	231	47	178	......	......
Acme, Dickson	104	7	35	......	......	9	31	1	4	......	......	34	123	......	......	54	255	35	166	......	......
" "	104 a	......	......	......	......	2	5	......	......	......	......	15	58½	......	......	17	75	34	146	......	......
" Vilmorin	105	......	......	......	......	......	......	2	4	......	......	......	......	......	......	30	143	35	198	......	......
" "	105 a	1	2	......	......	2	3	4	7	......	......	9	22	......	......	26	127	23	86	......	......
" Neuman	106	4	14	......	......	3	13	1	4	......	......	7	28	......	......	28	151	39	184	......	......
" "	106 a	1	5	3	8	......	......	......	......	......	......	27	63½	......	......	47	123	55	158	......	......
Livingston's Beauty, Rawson	107 a	......	......	......	......	2	8	1	3	......	......	2	13½	......	......	8	35	14	72	......	......
" " Livingston	108	......	......	......	......	......	......	......	......	......	......	......	......	......	......	18	115	36	228	......	......
" " "	108 a	3	9	2	3	......	......	......	......	......	......	2	4½	......	......	18	111	......	......	......	......
Climax, Rawson	109 a	27	65	8	17	2	5	11	34	......	......	60	146	......	......	101	299	78	222	......	......
Hovey, Thorburn	110 a	1	2	1	2	......	......	3	7	......	......	20	65½	......	......	37	151	19	74	......	......

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded from last page.)		Sept. 15.		Sept. 19.		Sept. 20.		Sept. 21.		Average weight of plants, oz.	Average number of fruits to plant.	Average weight of fruits on a plant, oz.	Average weight of a fruit in oz.	Ratio of weight of fruit to weight of plant.	Number of days in germinating.	Per cent.
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.							
Mayflower, Henderson	No. 75 a	167	427	--------	--------	556	910	--------	--------	157 1-3	136 2-3	286 11-12	2.099	1.823	10	28
" Root	76 a	180	616	--------	--------	1,000	1,654	--------	--------	117	228	460 1-2	2.02	3.935	9	54
" Neuman	77 a	484	1,323	--------	--------	2,074	2,69 ½	--------	--------	80	317 8-9	537 1-2	1.69	6.718	10	76
Scovill's Hybrid, Perry 86	78	26	100	--------	--------	621	1,727	--------	--------	119 1-3	114 1-2	351 1-6	3.066	2.944	7	30
" " " 87	79	25	120	--------	--------	480	864	--------	--------	128	102	248	2.431	1.937	8	48
" " "	79 a	31	135	--------	--------	348	553½	--------	--------	118 2-3	86 1-2	213 1-4	2.465	1.797	10	28
Rouge grosse, Vilmorin	80	--------	--------	--------	--------	336	737	--------	--------	81 1-3	102	293 1-6	2.874	3.604	8	56
Rouge grosse hative, Vilmorin	81	--------	--------	--------	--------	686	732	--------	--------	64	207 1-5	298 4-5	1.442	4.668	10	62
" " " "	82 a	--------	--------	--------	--------	239	561½	--------	--------	66	55 2-3	207 1-4	3.723	3.14	10	24
Rouge naine hative, "	83	--------	--------	--------	--------	597	990	--------	--------	109 1-3	176 1-2	446 1-4	2.528	4.081	7	46
" " " "	83 a	--------	--------	--------	--------	753	799	--------	--------	8[illegible] 2-3	210 1-6	309 1-3	1.471	3.742	10	34
Frühe rothe zwerg, Neuman	84 a	--------	--------	--------	--------	924	1,614	--------	--------	150 2-3	213 1-2	435 7-12	2.04	2.891	9	44
Cedar Hill, Neuman	86	135	558	--------	--------	557	1,230	--------	--------	106 2-3	159 1-6	468 5-12	2.942	4.391	9	86
" " "	86 a	157	580	--------	--------	870	1,690½	--------	--------	144	206 2-3	496 1-4	2.4	3.445	9	82
Gestreifte, "	87	106	303	--------	--------	204	564	--------	--------	80	119 1-3	321 5-6	2.696	4.022	10	88
Santa Catharina, Neuman	88 a	57	236	206	252	--------	--------	--------	--------	322 2-3	116 1-3	272 5-6	2.345	.845	11	10
Franz grosse rothe, "	89	--------	--------	530	814	--------	--------	--------	--------	86	136	273 1-3	2.009	3.178	10	86
" " " "	89 a	--------	--------	555	844	--------	--------	--------	--------	93 1-3	181 5-6	414 1-6	2.277	4.437	10	38
Glatte Amerikan, "	90 a	--------	--------	--------	--------	605	1,151	--------	--------	141 1-3	135	333 1-4	2.468	2.357	10	38
Mills' Belle, F. B. Mills	91	42	271	--------	--------	585	1,304	--------	--------	156 4-5	130 4-5	344 4-5	2.636	2.197	10	82
Extra Early or Cluster, Landreth	92	60	256	--------	--------	--------	--------	296	492	73 3-5	126	347 3-10	2.756	4.718	9	100
" " " "	92 a	144	687	--------	--------	--------	--------	285	934	85 1-3	93	377	4.053	4.418	10	48
Peach, Landreth	93	96	197	--------	--------	--------	--------	2,325	1,672	264	413 1-3	329	.795	1.246	8	90
Stamfordian, Dickson	94 a	159	497	--------	--------	--------	--------	906	1,630	88	223 2-3	475 11-12	2.127	5.408	9	58
Hackwood Park Prolific, Dickson	95	66	415	--------	--------	--------	--------	407	1,253	147 1-5	110 4-5	427 9-10	3.861	2.906	8	60
Jackson's Favorite, "	96	75	262	--------	--------	--------	--------	411	750	86 2-5	110 4-5	255 4-5	2.308	2.960	8	66
Feejee, Neuman	99 a	--------	--------	--------	--------	158	348	--------	--------	120	81	182 1-2	2.253	1.520	10	20
Rochester Favorite, Gregory	100 a	--------	--------	--------	--------	559	873	--------	--------	112	118 5-6	226 5-6	1.9	2.025	9	66
" Sibley	101	62	416	--------	--------	280	1,013	--------	--------	143 1-3	62 5-6	282 2-3	4 5	1.972	8	80
" "	101 a	107	341	--------	--------	166	601½	--------	--------	124	76 1-2	273 1-8	3.57	2.202	9	32
Livingston's Acme, Gregory	103	127	69	--------	--------	887	1,526	--------	--------	109 5-7	170 6-7	317 1-14	1.854	2.89	8	66
Acme, Dickson	104	179	924	--------	--------	--------	--------	550	1,042	117 1-3	144 5-6	430	2.968	8.664	8	64
" "	104 a	--------	--------	--------	--------	--------	--------	712	1,441	165 1-3	130	287 7-12	2.212	1.739	9	62
" Vilmorin	105	165	687	--------	--------	--------	--------	518	1,182	136	125	369	2.952	2.713	10	40
" "	105 a	--------	--------	--------	--------	--------	--------	958	1,536	129 1-7	147 4-7	254 5-7	1.726	1.979	9	76
" Neuman	106	135	482	--------	--------	--------	--------	912	1,928½	184	188 1-6	467 5-12	2.484	2.54	10	44
" "	106 a	143	364	--------	--------	799	1,123	--------	--------	41 3-5	215	368 9-10	1.715	8.867	9	36
Livingston's Beauty, Rawson	107 a	--------	--------	--------	--------	380	816	--------	--------	121 3-5	81 2-5	189 1-2	2.328	1.558	10	65
" " Livingston	108	74	495	--------	--------	402	991	--------	--------	124 4-5	106	365 4-5	3.45	2.931	9	62
" " "	108 a	--------	--------	--------	--------	--------	--------	484	940	141 1-3	84 5-6	177 11-12	2.097	1.258	10	36
Climax, Rawson	109 a	156	448	--------	--------	--------	--------	779	947½	252 4-5	244 2-5	436 7-10	1.786	1.727	9	31
Hovey, Thorburn	110 a	78	328	--------	--------	--------	--------	676	1,140	82 2-3	139 1-6	294 11-12	2.1	3.567	9	64

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded on next page.)		Aug. 17.		Aug. 20.		Aug. 22.		Aug. 25.		Aug. 31.		Sept. 1.		Sept. 5.		Sept. 8.	
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.
Optimus, Ferry	No. 114	4	12	......	......	......	......	......	......	14	66	......	......	32	123	25	110
" "	114 a	......	......	2	2	......	......	......	......	......	......	8	35	24	98	25	94
Cincinnati Purple, Ferry	115 a	10	23	3	4	......	......	6	12	......	......	21	37	86	231	39	238
Vick's Criterion, Henderson	117 a	......	......	10	20	1	3	......	......	......	......	10	20	25	54	17	38
" " Dickson	118 a	......	......	10	17	4	8	10	22	12	32½	......	......	21	47	24	58
King Humbert, Rawson	119	5	10	1	3	5	12	1	2½	4	5½	......	......	21	41	46	78
" " Dickson	120 a	......	......	2	2	......	......	1	2½	7	13½	......	......	17	29	18	26½
" " Vilmorin	121 a	4	5	22	21	6	7½	2	1½	95	85½	......	......	253	262	301	322
" " Neuman	122 a	......	......	......	......	......	......	......	......	2	2	......	......	30	39	55	78
Golden Queen, Rawson	124	2	5	1	2	......	......	......	......	21	37	......	......	44	126	42	122
" " "	124 a	1	2	......	......	......	......	......	......	10	36	......	......	14	55	30	125
Golden Trophy "	125	1	2	......	......	3	7	25	13	......	......	53	80	19	98	23	146
Yellow Victor, Gregory	126 a	......	......	......	......	......	......	......	......	......	......	98	133	44	151	43	144
Yellow Jefferson, Leonard	127	......	......	......	......	......	......	3	12	......	......	5	24	22	121	29	242
Jaune Grosse Lisse, Neuman	128	14	24	......	......	......	......	2	9	......	......	15	50	22	89	16	37
New White Apple, Thorburn	131	15	14	3	3	4	4½	......	......	......	......	22	27	40	53	108	142
" " " "	131 a	......	......	......	......	......	......	4	6	......	......	24	27½	34	43	68	86
Snowball, Nellis	132 a	......	......	3	3	......	......	......	......	......	......	15	17	28	35	70	90
Apfel Weisser, Neuman	133 a	......	......	2	3	......	......	......	......	......	......	5	5½	10	15	55	74
Green Gage, Henderson	134	13	8	10	6½	8	6	6	3	......	......	82	59	234	163	425	280
" " "	134 a	12	6	15	12	......	......	5	3	......	......	72	57	332	265	278	192
" " Neuman	135 a	......	......	......	......	......	......	......	......	......	......	5	6	54	97½	33	75
" " Dickson	135½ a	1	1	......	......	......	......	2	3	......	......	26	41	24	42½	60	92
Large Yellow, Sibley	136	2	2	......	......	......	......	2	3	......	......	9	20	18	51	32	68
Little Gem, Gregory	137	......	......	......	......	4	7	10	19	......	......	16	27	17	26	142	265
" " Neuman	138 a	......	......	6	2	7	9	23	28	......	......	83	105	38	38½	183	240
Red Cherry, Henderson	139	......	......	......	......	8	1½	7	4	......	......	90	22	35	7	62	13½
" "	139 a	42	7	......	......	16	3	13	2½	......	......	108	22	91	17	100	20
Kirsch rothe, Neuman	140 a	65	16	4	1	18	5	16	4	......	......	105	28	55	14	60	20
Yellow Cherry, Thorburn	141	......	......	9	1½	14	1½	17	2	......	......	94	12½	77	9	170	19
Gelbe Kirsch, Neuman	142	......	......	......	......	......	......	......	......	......	......	13	6	20	13	45	38
" " "	142 a	......	......	......	......	3	3	......	......	......	......	15	5	16	10	65	38
Cerise, Vilmorin	143	......	......	......	......	......	......	4	1½	......	......	32	16	38	18	255	72½
Pear shaped, Henderson	146	......	......	......	......	......	......	......	......	......	......	12	7	15	10	98	72
Poire, Vilmorin	148	56	8	7	1½	......	......	104	15½	......	......	11	2	36	13	182	68
" "	148 a	5	2	......	......	......	......	3	1	......	......	12	4	26	10	232	85
Wonder of Italy, Burpee	149	......	......	......	......	......	......	......	......	......	......	16	11	26	18½	247	200
" " "	149 a	......	......	......	......	......	......	......	......	......	......	12	12	32	34	17	15

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded from last page.)		Sept. 15.		Sept. 21.		Sept. 22.		Average weight of plants, oz.	Average number of fruits to a plant.	Average weight of fruits on a plant, oz.	Average weight of a fruit in oz.	Ratio of weight of fruit to weight of plant.	Number of days in germinating.	Per cent.
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.							
Optimus, Ferry	No. 114	47	257	448	261	--------	--------	136	95	138 1-6	1.454	1.015	8	44
" "	114 a	83	287	800	1,240½	--------	--------	148	157	292 3-4	1.864	1.977	9	18
Cincinnati Purple, Ferry	115 a	156	439	647	1,052	--------	--------	160	193 3-5	407 1-6	2.103	2.544	10	49
Vick's Criterion, Henderson	117 a	73	227	1,305	2,040	--------	--------	198⅔	240 1-6	400 1-3	1.666	2.015	10	32
" " Dickson	118 a	86	220	928	1,398	--------	--------	130⅔	182 1-2	300 5-12	1.646	2.299	10	54
King Humbert, Rawson	119	269	399	1,431	1,165	--------	--------	93⅓	297 1-6	286	.962	3.064	7	56
" " Dickson	120 a	62	104	618	604	--------	--------	124	362 1-2	390 3-4	1.077	3.151	12	28
" " Vilmorin	121 a	587	537	5,925	2,370	--------	--------	161	719 1-2	361 3-20	.501	2.245	10	76
" " Neuman	122 a	118	140	2,376	1,730	--------	--------	137⅓	430 1-6	331 1-2	.77	2.413	9	50
Golden Queen, Rawson	124	74	249	660	1,012	--------	--------	109⅓	140 2-3	258 5-6	1.84	2.367	10	74
" " "	124 a	72	286	645	1,171	--------	--------	124	128 2-3	279 1-6	2.169	2.251	11	26
Golden Trophy, "	125	30	159	427	872½	--------	--------	154⅔	96 5-6	229 7-12	2.37	1.484	7	34
Yellow Victor, Gregory	126 a	71	245	235	572	--------	--------	90⅔	163 2-3	415	2.535	4.577	10	48
Yellow Jefferson, Leonard	127	52	307	--------	--------	501	1,133½	168⅔	102	306 7-12	3.005	1.817	8	62
Jaune Grosse Lisse, Neuman	128	49	248	--------	--------	523	1,358	166	160 1-4	453 3-4	2.831	2.733	7	60
New White Apple, Thorburn	131	172	173	--------	--------	180	121	176	544	537 1-2	.988	3.054	8	72
" " " "	131 a	171	178	--------	--------	1,151	748	183⅓	242	181 5-12	.749	.989	11	70
Snowball, Nellis	132 a	145	188	--------	--------	1,508	1,092	173⅓	294 5-6	237 1-2	.805	1.37	11	38
Apfel Weisser, Neuman	133 a	137	184	--------	--------	1,755	1,340	240	327 1-3	270 1-4	.825	1.126	10	26
Green Gage, Henderson	134	643	444	--------	--------	635	206	112	2,056	1,175 1-2	.571	10.495	8	64
" " "	134 a	558	300	--------	--------	524	164	96	1,796	999	.556	10.405	11	20
" " Neuman	135 a	142	169	--------	--------	1,180	1,043	224	235 2-3	231 3-4	.981	1.034	10	63
" " Dickson	135½ a	118	141	--------	--------	1,320	1,028½	242	258 1-2	224 5-6	.87	.929	11	87
Large Yellow, Sibley	136	96	368	--------	--------	498	524	382	164 1-4	259 3-4	1.581	.68	9	60
Little Gem, Gregory	137	145	245	--------	--------	280	204	208	614	793	1.291	3.812	9	42
" " Neuman	138 a	146	160	--------	--------	141	79	176	627	661 1-2	1.055	3.758	9	56
Red Cherry, Henderson	139	363	48	--------	--------	186	112	240	751	208	.277	.866	10	72
" " "	139 a	------	------	--------	--------	776	66	124	1,146	137 1-2	.12	1.108	10	80
Kirsch rothe, Neuman	140 a	320	68	--------	--------	581	79	192	1,224	235	.192	1.192	9	70
Yellow Cherry, Thorburn	141	------	------	--------	--------	1,050	73	140	1,431	118 1-2	.082	.846	10	48
Gelbe Kirsch, Neuman	142	------	------	--------	--------	500	179	200	578	236	.408	1.18	10	52
" " "	142 a	------	------	--------	--------	424	152	152	523	208	.398	1.368	9	62
Cerise, Vilmorin	143	------	------	--------	--------	655	151	120	984	259	.263	2.158	10	82
Pear shaped, Henderson	146	38	20	--------	--------	347	112	160	510	221	.433	1.381	9	54
Poire, Vilmorin	148	100	29	--------	--------	754	114	168	1,250	251	.2	1.494	9	88
" "	148 a	64	17	--------	--------	482	77	152	824	196	.237	1.29	11	50
Wonder of Italy, Burpee	149	73	47	--------	--------	318	100	154	680	376 1-2	.553	2.444	10	30
" " "	149 a	62	63	--------	--------	264	130	152	387	254	.656	1.671	10	80

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded on next page.)		Aug. 17.		Aug. 18.		Aug. 20.		Aug. 22.		Aug. 25.		Sept. 1.		Sept. 6.		Sept. 8.	
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.
Queen of Tomatoes, Dickson	No. 150 a	8	2							3	1	4	1	34	12½	59	21
Nisbits Victoria, Nellis	151							7	3½			7	2	31	11½	61	25
" " "	151 a	12	6									20	9	40	18	25	12½
" " Dickson	152 a	11	4							2	1	10	4	22	11½	18	10
Yellow Plum, Henderson	153	8	4			2	1	6	2			14	5	39	16	24	14
" " "	153 a			13	7	3	2	4	2	4	2	24	12	36	20	28	15
Eiformige Dauer, Small, Neuman	154											6	6½	14	15	17	18½
" " (Ignotum) Large, Neuman	154	1	2			1	3	4	11½	3	16	23	115	43	196	9	40
Mikado, Henderson	155	11	42			6	18					23	145	85	510	17	150
Potato Leaf, Livingston	161	13	28					11	42			40	173	85	356	23	62
New French Upright, Thorburn	162									7	22	3	19	1	4½		
Rouge à tige raide de Laye, Vilmorin	163													4	25	21	70
Grenier mit aufrechten stamme, Neuman	164											1	3	4	15½	1	4
Station Tomato, Ripe, N. Y. Ex. Station	165	1	1									4	7	3	8	1	4
" " Green, " " "	165													14	50	5	9
New Currant, Thorburn	166	9	1							8	1	261	13	232	11	56	3
" " "	166 a	32	2			18	1½			34	2	715	34½	511	21	107	4½
Rothe Johannes beerfruchten, Neuman	167 a			25	1½	28	2	33	1½	42	2	392	19	282	12½	207	9
Sunset, Tillinghast	168			6	16									18	75½	11	52
" "	168 a					3	10			3	7	18	46	36	157½	24	96
Puritan, Rawson	170							1	2½			4	19	20	123	13	84
Americus Hybrid, Faust	171			10	35					3	10	14	64	29	192	17	133
Dwarf Champion, Henderson	172			2	11							9	32	20	89½	18	81½
Glen Cove, Burpee	173			2	8					1	2	1	7	6	29		
New Bay State, Bragg	174			1	6							1	4½	24	50	3	18
Volunteer, Hallock	175									1	4			16	91½	14	74
King of the Earlies, Ely	176			2	3	2	2			4	17	61	195	134	396½	58	188
Potato Leaf, Mills	177			5	14			1	1½			25	57	54	236	14	75½

COMPARATIVE TABLE.—CONTINUED.

Name and Number of Variety. (Concluded from last page.)		Sept. 10.		Sept. 15.		Sept. 22.		Average weight of plants, oz.	Average number of fruits to a plant.	Average weight of fruits on a plant, oz.	Average weight of a fruit in oz.	Ratio of weight of fruit to weight of plant.	No of days in germinating.	Per cent.
		No. ripe.	Weight, oz.	No. ripe.	Weight, oz.	No. ripe.	Weight, oz.							
Queen of Tomatoes, Dickson	No. 150 a	......	......	133	43	891	176	112	1,132	256 1-2	.226	2.29	10	75
Nisbit's Victoria, Nellis	151	......	......	115	32	529	133	144	750	207	.276	1.437	9	78
" " "	151 a	......	......	119	35	653	164	124	869	244 1-2	.281	1.971	10	63
" " Dickson	152 a	......	......	82	43	1,261	317	188	1,406	390 1-2	.277	2.077	9	92
Yellow Plum, Henderson	153	......	......	75	25	498	91½	112	666	158 1-2	.238	1.415	7	86
" " "	153 a	......	......	65	29	656	171	144	833	260	.312	1.805	10	56
Eiformige Dauer, Small, Neuman	154	......	......	33	34	2,394	1,566	250⅔	410 2-3	273 1-3	.665	1.09	7	86
" " (Ignotum) Large, Neuman	154	......	......	57	280	386	866	140	87 5-6	254 11-12	2.9	1.82	8	86
Mikado, Henderson	155	......	......	150	1,027	387	1,351	65⅓	75 4-9	360 1-3	4.77	5.515	8	56
Potato Leaf, Livingston	161	......	......	155	580	680	1,595	56	125 7-8	354 1-2	2.816	6.329	10	30
New French Upright, Thorburn	162	4	26½	3	11	25	64	41⅓	14 1-3	49	3.418	1.185	10	12
Rouge à tige raide de Laye, Vilmorin	163	5	28½	17	88	41	114	35⅓	14 2-3	42 7-12	2.9	1.205	10	30
Grenier mit aufrechten stamme, Neuman	164	2	8	16	41	47	104	37⅓	11 5-6	29 1-4	2.47	.783	12	30
Station Tomato, Ripe, N. Y. Ex. Station	165	8	25	5	11	52	35½	26⅔	24 2-3	30 1-2	1.236	1.144	12	10
" " Green, " " "	165	......	......	8	22	79	100	17	13 1-4	22 5-8	1.707	1.33	12	26
New Currant, Thorburn	166	......	......	510	16	5,049	128	72	6,125	173	.028	2.402	8	92
" " "	166 a	......	......	679	24	6,020	110	32	8,116	199 1-2	.024	6.234	9	46
Rothe Johannes beerfruchten, Neuman	167 a	......		584	21	3,505	70	38	5,098	138 1-2	.027	3.644	9	84
Sunset, Tillinghast	168	......	......	59	272	778	1,572	256	145 1-3	331 1-4	2.279	1.293	9	44
" "	168 a	......	......	51	381	729	1,396	133⅓	144	345 7-12	2.4	2.591	9	52
Puritan, Rawson	170	......	......	51	335	533	1,267	149⅓	103 2-3	305 1-12	2.942	2.712	8	66
Americus Hybrid, Faust	171	......	......	67	424	572	1,363	136	118 2-3	370 1-6	3.119	2.721	11	22
Dwarf Champion, Henderson	172	......	......	36	151	415	784	54	83 1-3	191 1-2	2.298	3.546	11	50
Glen Cove, Burpee	173	......	......	32	205	427	998	133⅓	78 1-6	208 1-6	2.663	1.561	9	78
New Bay State, Bragg	174	......	......	60	381	700	1,648	197⅓	131 1-2	351 1-4	2.671	1.78	9	58
Volunteer, Hallock	175	......	......	68	312	571	1,476	224	134	391 1-2	2.921	1.747	10	48
King of the Earlies, Ely	176	......	......	184	612	669	1,693	88	185 1-6	517 3-4	2.796	5.883	10	84
Potato Leaf, Mills	177	......	......	47	224	1,036	1,883	226⅔	197	415 1-6	2.107	1.831	10	56

NO. 49.—DEPARTMENT OF CHEMISTRY.

CHEMICAL COMPOSITION OF—

1. CORNSTALKS AND ENSILAGE AT DIFFERENT PERIODS OF GROWTH.
2. MARSH HAY FROM PAW PAW.
3. WHEAT SCREENINGS FROM KALAMAZOO.

CORNSTALKS AND ENSILAGE.

The chemical composition of cornstalks at different periods of growth, and of the ensilage made from the same, has been a matter of inquiry by intelligent farmers and stockmen, in order to fix upon the time for cutting fodder corn to secure the best results. The following investigation has been made as a contribution to this subject, and, while the results are not as decisive as could be desired, it is hoped they will be of some value in settling this question.

Fodder plants at earlier periods of growth have greater food value, pound for pound of dry matter, than the same plants at complete maturity, because, in ripening, a part of the carbhydrates pass into indigestible condition as woody fibre. But the total food value produced on an acre greatly increases with advanced growth, from the rapid increase of digestible material along with this increase of woody fibre.

The acreage food value of a fodder crop will be at its maximum when there is the largest amount of digestible albuminoids and carbhydrates, and the least relative amount of indigestible fibre. The percentage chemical composition, therefore, will have to be interpreted with reference to this acreage increase of the crop.

The food value may be computed in three ways:

1. By chemical composition.
2. By digestion experiments.
3. By feeding stock.

The last method would seem to be the most natural and decisive. There are two objections to it. First, a number of animals must be fed in order to eliminate the personal differences in feeding quality in different animals. Second, animals require a change of food, and will not thrive if confined to one kind of food for some time.

A combination of chemical analysis and digestion experiments promises the best results. The work this year has been mainly devoted to the chemical analysis.

The plan adopted was to gather a specimen of corn as soon as it tasseled, make a chemical analysis of a part, and place the balance in a silo for future analysis, and repeat this process every week until the corn was fully ripe. In practice, however, the fresh stalks were examined for the amount of water and dry matter at each cutting, and a quantity of the cut stalks was rapidly dried and saved for subsequent analysis.

The field of corn assigned for this investigation was planted with Burrill & Whitman's ensilage dent corn; planted in drills 3 feet 9 inches apart and one stalk on the average to every 10 inches in the row. The corn was choked for want of air space, and in central parts of the field formed few ears, and those poorly developed. The first cutting was on the 25th of August, the stalks being left in small bundles to wilt till the 27th, when the stalks were cut by a Champion hand cutter into pieces three-quarters of an inch long. A quantity of fresh stalks was secured on the 27th and cut in the same way, the wilted stalks being entered on the table as No. 1 and the fresh stalks as No. 2.

The cut material was immediately placed in small silos, pressed down firmly, and finally compressed by a strong screw and securely fastened. The silos were strong oak casks, with sides nearly straight, and strongly bound with iron hoops. A tightly fitting head completed the silo. The head was forced down by a strong screw, an "apple heading press" being used for the purpose. At intervals of one or two weeks the heads were screwed down as far as possible, and then fastened by cleats nailed on the inside of the cask. These silos answered the purpose very satisfactorily; a little mildew and decomposition at the surface, but the interior in excellent condition when opened in January, the silage having a pleasant odor of acetic ether and an agreeable taste.

No. 3 was cut for wilting September 1 and No. 4 was cut September 3, and both placed in the silo September 3. Nos. 5 and 6 were treated in the same way, September 8 and 10. On September 13 there was such strong indications of frost that No. 7 was gathered and placed in the silo at once. A killing frost on the morning of September 14 put an end to this part of the experiment.

The following table exhibits the percentage of dry matter in the wilted stalks, fresh stalks, and the ensilage made from them:

Condition of Stalks at time of Ensiling.	Corn Stalks.	Ensilage.	Day of Cutting.
No. 1—Wilted in two days	22.00	19.00	Aug. 25
No. 2—Fresh Stalks	17.25	16.00	Aug. 27
No. 3—Wilted two days	27.60	22.30	Sept. 1
No. 4—Fresh Stalks	21.70	16.25	Sept. 3
No. 5—Wilted two days	27.00	21.32	Sept. 8
No. 6—Fresh Stalks	21.98	18.60	Sept. 10
No. 7—Fresh Stalks	21.96	19.72	Sept. 13

The loss of dry matter in the process of ensiling, an average of 16 per cent, will attract attention.

Sept. 3rd to 5th, specimens of corn were obtained from the farm department much more mature than the preceding numbers, and they are placed in the following table:

Hathaway Dent, ears glazing, per cent dry matter	26.44	Breck's Boston Market fodder corn (ears), per cent dry matter	28.22
Parish White Dent fodder corn, " " "	24.46	White Dent fodder corn (ears), per cent dry matter	34.97
Leaming fodder corn, " " "	23.23		

The chemical composition of the various specimens of cornstalks and ensilage from the same, will be found in the following table, the composition being expressed in per cent of the dry matter. In the same table is given the composition of ensilage from the farm department, made from corn not fully in the ear; and also as a curiosity, ensilage from corn that had been thoroughly frostbitten on a neighboring farm:

COMPOSITION OF CORNSTALKS AND ENSILAGE—PER CENT OF DRY MATTER.

	No. 1. Wilted.		No. 2.		No. 3. Wilted.		No. 4.		No. 5. Wilted.		No. 6.		No. 7.		Hathaway Dent.	Laboratory Ensilage.	Farm Ensilage.	Parish White Dent.	Leaming Fodder.	Breck's Boston Market.	White Dent.	Ensilage from Farm.	Ensilage from Frosted Corn.
	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.	Cornstalks.	Ensilage.									
Crude fiber	27.87	30.75	31.15	32.30	28.72	28.35	27.27	30.30	28.61	29.70	28.52	30.20	26.79	29.50	19.50	20.46	19.20	25.25	24.32	24.57	21.65	28.72	23.60
Crude protein	8.87	10.06	10.06	9.37	9.19	9.19	10.87	8.10	8.97	7.44	9.19	7.87	8.31	7.09	8.63	7.81	8.06	7.60	6.56	8.50	8.09	9.13	6.56
Ether extract—fat	2.50	4.75	2.30	4.50	2.30	4.45	2.52	4.00	2.25	3.85	2.15	3.75	2.25	3.55	2.10	4.20	4.00	1.65	1.50	1.75	2.40	5.00	3.50
Nitrogen free extract	54.23	47.67	48.71	47.25	53.77	50.46	53.18	50.32	54.63	53.06	54.57	51.63	58.09	54.42	66.57	64.24	65.46	59.25	61.76	61.87	63.47	49.27	60.26
Acetic acid	------	1.10	------	1.02	------	.95	------	.92	------	.87	------	.80	------	.82	------	.96	.61	------	------	------	------	1.29	1.50
Pure ash	6.53	6.77	7.78	6.58	6.02	7.55	6.16	7.28	5.54	5.95	5.57	6.55	4.56	5.44	3.20	3.29	3.28	6.25	5.86	3.31	4.39	7.88	6.08
Organic Nitrogen—																							
Total nitrogen	1.42	1.61	1.64	1.50	1.46	1.47	1.75	1.30	1.44	1.19	1.47	1.26	1.33	1.13	1.38	1.25	1.29	1.23	1.05	1.34	1.29	1.46	1.05
Albuminoid	1.05	.98	1.25	1.06	1.08	.95	1.30	.82	1.19	.78	1.19	.74	1.16	.67	1.09	.68	.81	1.01	.88	1.05	1.12	.87	.70
Amide	.37	.63	.39	.44	.38	.52	.45	.48	.25	.41	.28	.52	.17	.46	.29	.57	.48	.22	.17	.29	.17	.59	.35

REMARKS ON THE PRECEDING TABLE.

1. The amount of crude fibre (woody matter) relatively diminishes as the corn approaches maturity, because there is so large increase of nitrogen free extract (starch, sugar, gum, etc.) This is distinctly seen in the Hathaway Dent, Breck's Boston Market, and White Dent, the three kinds having corn well developed, the first named being nearest ripe.

In the silo the crude fibre appears to increase, because of a sensible loss of carbhydrates (nitrogen free extract) from fermentation.

2. Crude protein includes all the nitrogenous materials usually called albuminoids, and certain materials of less value as food, called amides.

A small loss of crude protein is common in the silo, but the change from albuminoid to amide condition of the nitrogen compounds is the most striking feature of ensiling. These two facts would point to a loss of value in ensilage as compared with fresh cornstalks, or even the dry material when it has been rapidly and perfectly cured.

3. Ether extract includes not only the fat, but the waxy material, much of the coloring matter, etc. The notable increase of the ether extract in the ensilage, as compared with the cornstalks before ensiling, will attract attention. It can hardly be supposed that carbhydrates are converted into fat in the silo.

4. The marked increase of nitrogen free extract (members of the starch family) as the corn matures, and the progressive decrease of acid in the ensilage, show how greatly the corn improves as it approaches ripening. The relatively large amount of water and crude fibre in the young plant justifies the epithets "slush," and "swill," as applied to the ensilage made from such material.

The progressive decrease of percentage of ash as the plant matures is worth notice. In the experimental cuttings, No. 1 to No. 7, this change is seen, also, the small amount of ash in the riper specimens: Hathaway Dent, Breck's Boston Market and White Dent, and the larger amount in Parish White Dent and Leaming Fodder. This decrease follows the usual law in plant growth.

MARSH HAY.

The wild grasses (sedges) that grow so abundantly in the marshes in many parts of Michigan are often mowed and cured for hay. The value of this marsh hay for fodder is a matter of uncertainty in public estimation, and the experiment station has been invited to investigate and report.

The value of this marsh hay will depend upon the kind of "grasses" used, and the period of cutting, and the manner of curing. The coarse sedges, covered with a sharp silicious crust when ripe, will make very inferior hay, but the fine sedges made into hay before hardening and ripening, will make a much better fodder.

A good specimen of such marsh hay was obtained from Hon. A. C. Glidden of Paw Paw, who spoke highly of its feeding quality. The analysis of this material is given below, and shows that it compares favorably with the average of timothy hay.

COMPOSITION OF MARSH HAY.

Water, per cent	7.86
Ash. "	4.20
Crude fiber, per cent	27.55
Albuminoids	7.00
Ether extract—fat	3.60
Nitrogen free extract—carbhydrates	49.97
	100.00

This material contained no amides.

WHEAT SCREENINGS.

A gentleman in Kalamazoo sent to this station two packages of wheat screenings for analysis, to learn something of their value as food for stock.

The screenings consist of broken grain, shrunken wheat, chess, cockle, seeds of weeds (pea vine especially), and fragments of straw, chaff, etc.

The screenings were analyzed, and the results appear in the following table:

COMPOSITION OF WHEAT SCREENINGS.

	No. 1.	No. 2.
Water, per cent	7.80	8.40
Ash	3.80	3.76
Crude fiber	4.95	6.10
Crude protein	14.78	15.06
Ether extract—fat	2.65	3.03
Nitrogen free extract	66.02	63.65
	100.00	100.00
Nitrogen, total	2.36	2.41
Albuminoid nitrogen	2.00	2.14
Amide nitrogen	.36	.27

Shrunken and immature wheat has little value for making flour, and many persons suppose that its food value is of a low order. But young grains are richer in nitrogen compounds than the fully ripened and plump berry. The value of such grains for stock feeding is not to be measured by their flour producing quality. These wheat screenings are worth more for stock food than the same weight of plump wheat. The value of such materials when ground and fitted for mixing with coarse materials like straw, etc., is obvious to the intelligent stock feeder. The material should be ground to kill all seeds of weeds, as well as to secure complete digestion.

In presenting the material for this bulletin, I wish to acknowledge the valuable labors of G. L. Teller, my efficient assistant in the work of the experiment station.

R. C. KEDZIE,
Chemist, Experiment Station.

Agricultural College, May, 1889.

NO. 50—ZOÖLOGICAL DEPARTMENT.

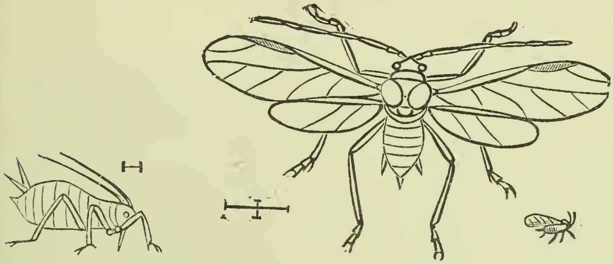
THE GRAIN PLANT LOUSE.

Aphis (Siphonophora) avenæ.

The present season is characterized by one of those wide-spread and very damaging insect invasions that is so discouraging to the farmer. I refer to the present onslaught on the wheat crop by the grain aphis or plant louse, *Aphis avenæ.* This louse attacks wheat, barley, oats and rye, and is to be found in small numbers on these grains every year. This year occurs one of those terrible attacks that seem to threaten very serious loss. This raid extends from Ohio west to Indiana and north to Grand Rapids, Michigan. Of this much I am certain. I do not know whether it reaches in such overwhelming numbers to other States or not. So abundant are these lice that they have attracted wide attention and awakened serious alarm. For the past two weeks I have received daily numerous specimens of these lice with the inquiry: What is to be the outcome of this attack? I have received as high as fifteen such communications in a single day.

WHAT IS IT?

This is a plant louse, or aphis, and is very similar to those that attack our house plants, cherry, plum and apple trees (see Fig.), cabbages and hops. Indeed, so numerous are the species of these lice that hardly one of our valued plants but has its plant-louse enemy. These plant-lice (see Fig.) have flask-shaped bodies, are usually green or black, though sometimes they are yellow or red, and are usually quite small. In looking at the grain aphis at this season (see Fig.) four forms will be seen: a small wingless louse, a large wingless form—the full grown apodous or wingless louse; the pupa of the winged louse, which has short wing pads; and the mature winged louse. We usually find these four forms at some season of the year in all plant lice colonies. Frequently, and this was true a few days ago of this grain aphis, we only find the wingless forms. Later the pupæ with wing-pads and the fully developed winged forms are seen. These winged lice are doubtless developed that the lice may spread before their food is wholly destroyed and they confronted by famine. The mature wingless louse of this grain aphis is about one-tenth of an inch long. The winged louse is nearly twice as long to the end of the wings. This louse is not quite as slim as is aphis mali (see Fig.). As will be observed by



Apple Tree Plant Louse.—*Appis Mali.*
Winged form natural size and much magnified. Wingless form much magnified. Short lines show natural size.

examining the lice, or by studying the figure, these lice have long, seven-jointed antennæ—the horn-like organs appended to the head, and the winged lice have simple veined wings. The main vein of each wing is branched. There are four branches in the front or primary wings. The outer one is strongly curved and the next one branches twice. There are two simple branches on the posterior wing. This style of venation is characteristic of the genus aphis. We also note (see Fig.) that there are two short spine-like projections, black in the grain aphis, on the third part of the abdomen. These are the nectaries or honey tubes, so called because there frequently exudes from them a nectar which attracts ants and bees to these lice. Just now (June 26, 1889) a species of plant louse on our Norway spruces are secreting nectar so profusely that in the early morning it stands on the leaves in drops, so that it can be tasted. It seems very pleasant to the taste, and is giving the bees a fine harvest. This peculiar physiological characteristic serves the louse in this way: by attracting ants, wasps and bees, the birds and insect enemies of the lice are frightened away. I find that the oats and wheat are visited by ants that the nectar secreted by this grain aphis may be secured. The beak of this grain aphis is strong, dark in color, and about one-third the length of the body. With this the louse sucks the sap and devitalizes the plants. The feet and joints of the legs and also the antennæ are dark or dusky in color.

The color in these lice varies greatly. Early in the season while they are on the leaves or stalks they are green. This is the color now of all healthy lice on the oats. After they migrate to the heads they often turn yellowish green and even rust red, though I find that now the green color prevails even with the lice which are gathered thickly about the kernels. Some of the winged lice are very dark, almost black. In these the legs are nearly all black. It is probable that the nature of the food affects the color. As the berries mature I think the yellow and red colors will prevail to a larger degree.

REPRODUCTION OF THE LICE.

The reproduction of plant lice is very curious. Late in the season we find both sexes. This is the only time that we find males. The sexes now pair, and eggs are laid about buds, in crevices, or where they will best survive the winter. In the spring only females hatch from these eggs. These do not lay eggs, but each gives birth to from three to five lice each day. In about four or five days these young lice begin to produce living lice, each contributing daily its four or five new lice to help on the general devastation. Such early and rapid breeding implies great nutrition, and we easily understand why the plants wither and dry up. We also see how the lice become so quickly numerous and widespread. Calculation shows that in less than a month, if no lice died or were killed, a single louse might be the progenitor of more than several million lice. To follow the number further defies comprehension. Many have written me: "We can not imagine where the lice could come from so quickly and rapidly." The above fact explains this physiological riddle.

WHY SO NUMEROUS THIS YEAR.

This is not the first season that this Aphis avenæ has come like a destroying flood upon the grain fields. In 1861 the lice swarmed upon the cereal crops of New England and New York, at which time Dr. Asa Fitch fully described it in his sixth report. In 1866 and again ten years later it did great damage in various sections of the west. We see then that this louse does not come yearly but only at long intervals. Why is this? It is doubtless owing in some measure to the weather, but more to its insect enemies. We readily see that its enormous prolificness would make it as the sands of the sea shore every year, except that some natural agent held it in check. Fitch describes three such enemies. Even now as we visit the oat and wheat fields we find many forms different from any previously described. These have short, rounded bodies, which are of a dirty white color. The cause of this is that these are attacked by parasites, which are eating them up. We have reared several of these little benefactors, and find them now busily engaged in the fields laying the eggs that will destroy the lice. These minute parasitic insects lay a great many eggs, one in each louse, and their presence and prosperity mark the doom of the lice. Thus through the agency of these minute parasitic forms, aided by climatic influences, we are to be saved from a raid by this grain aphis next year, and will be greatly benefited this year. Indeed, in some cases, these little friends will very likely save us from serious damage. Why the parasites are not able to come successfully to the rescue each year is still unknown. Very likely this problem will receive a very valuable practical solution in the future. In these parasites the entomologist sees the doom of the lice, but not, I fear, till great harm is done. Dry weather is a great promoter of insect productiveness. It is more than probable that the exceeding drought of 1887, 1888 and of the April and May just past, together with the mild winter of 1888 and '89, have had much to do with the present invasion. We might expect much aid from our frequent June rains, but I fear they were too late. Observation shows that the lice are more than holding their own, so we may conclude that the warm rains are not greatly depleting their ranks.

WHAT TO EXPECT.

Where the lice are very numerous, as they seem to be over a widespread area of our country, they must do great injury. Where ten or twelve lice are collected about a single kernel of wheat, as I have actually seen in the past few days, there is little hope for that kernel. I have counted one hundred and sixty lice on a single head of wheat. It is hoping too much of the little parasitic flies to expect them to save the present crop. We can but expect much injury, especially where the lice are in such countless numbers as are now seen in many of our wheat fields of Indiana, Ohio and Michigan.

WHAT OF REMEDIES.

The excellent specific against plant louse ravages, the kerosene and soap mixture, cannot be used without much injury to the crop. To apply it might be like the jump from frying pan to fire. Again, the lice are so protected by the close cluster of the kernels that very likely the remedy would not be fully effective. I could not, therefore, recommend its application in this case. We are now making extensive and accurate experiments, so that at time of a future raid we can speak with positiveness in this matter. We are aiming to find just what the damage is, just how many lice it requires on a head or kernel to blast it, and just how effective the remedy is, and how serious the damage of its application will be to the plants.

INCORRECT NAME.

The name "green midge," which is going the rounds of the papers, is very incorrect, and should not be used. The Hessian fly and wheat midge are very different insects. These midges are two-winged flies, whose larvæ are footless maggots. They belong to the great two-winged fly order, Diptera, while these are plant lice, or aphides, and belong to the order of bugs, or Hemiptera. Let all speak of this as the grain aphis, or plant louse, and not as the green midge, which is entirely wrong, as they are not always even green in color.

A. J. COOK.

June 27, 1889.

NO. 51—ZOÖLOGICAL DEPARTMENT.

ENEMIES OF THE WHEAT APHIS.

The importance of parasitic and predaceous insects in overcoming our insect pests, has long been recognized by the practical entomologist. He sees the destroyers swept off as by a flood; and sees in these prolific friends the easy solution of the problem of insect years. He knows that were it not for these friends, the destroying hosts would make our earth a desert, and replace plenty with famine. He knows that adversity among these tiny helpers means success to the swarms of insects that devour the crops, and so is rejoiced when he see these little helpers active and numerous.

The present season has furnished a vivid illustration of this important and interesting fact. Ten days ago, June 30, the heads of wheat were crowded with hungry aphides, or plant lice. These myriad lice, often five or six around a single kernel of wheat, and two hundred on a single head, were sucking the sap and very vitality from the forming kernels. They were rapidly blighting the grain, and unless some friendly hand were raised against them the wheat crop would be utterly ruined. Even then, when the lice were countless in numbers, and when the winged forms were rapidly spreading to the oat fields, the hand of deliverance was easily discerned in the comparatively few but wondrously prolific enemies of the lice which had already sounded a halt in the march of destruction. A week later and the enemies of the lice were in the ascendency, and to-day the lice are nearly exterminated, and the wheat crop is rescued and the oat crop saved. Close observation easily demonstrates these truths. Even the careless eye can see the savage insects dining on the lice, or the fatal egg laid which dooms the louse which receives it.

The fact that farmers are noticing these insect friends, and have now an object lesson which should be rightly understood and carefully studied, leads me to send out this bulletin. Ten days ago I was receiving scores of letters asking about the lice; to-day I am receiving as numerous inquiries regarding these friends. That instruction is opportune is evident from such questions as this: "Are these insects going to complete the destruction so actively begun by the lice?"

BENEFICIAL INSECTS.

There are two groups of these insect friends; predaceous and parasitic insects, both of which are well illustrated on the heads of wheat of our fields to-day. Predaceous insects are such as devour their prey, much as the cat or weasel devours the mouse. Parasitic insects are those that lay their eggs on or in their victims. When these eggs hatch the larval parasite proceeds to feast on its host, which thus serves it for both home and food. In the case before us, as soon as the parasite has devoured the viscera of the louse, it uses the skin or crust as a sort of cocoon. These gray, circular cocoons (Fig. 1) are now thick among the kernels of every head of wheat, and must have been noticed by every observer who has taken pains to examine.

The Wheat Louse Parasite.

This tiny black fly is by far the most important of these littls friends that have come to the farmers' rescue and saved the wheat, barley and oat crops.

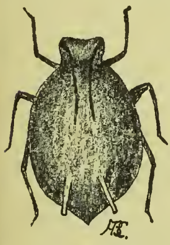


Fig. 1—Parasitized louse.

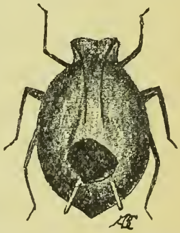


Fig. 2.—Parasitized louse, showing exit opening.

The lice that are the victims of these eager parasites are easily distinguished. They (Fig. 1) are short, rounded and gray in color. After the larva disembowels the lice it uses the dry, thick skin as a cocoon, in which it changes to a pupa. Very soon the mature insect comes forth from a small round hole in the upper, hinder part of the abdomen (Fig. 2), and very soon mates and commences to lay its many eggs in new victims. Of course, these parasitic larvæ fairly swim in the rich nutritious blood of the lice, and so are rapidly developed. Thus we see how it is that the parasites are too much for the lice. Prolific as are the lice, and rapid as are they in development, yet the parasites are even more so, and thus it is that in ten days the parasites have so outnumbered the lice that the latter have been routed and driven from the field. The little flies are just about one-tenth of an inch in length. They are black above and yellowish brown beneath. The antennæ are black, while the front, mouth parts and legs are yellowish brown. In some specimens the femora and tarsi are dusky, and the under side of the abdomen quite dark. Occasionally we find specimens with the upper part of the abdomen brownish, except the pedicel and tip. There seems much variation in the color of abdomen and legs, though in most cases the dorsal surface is black, and the ventral surface and legs brown. The occiput or collar connecting the head and throax is brown. The antennæ (Fig. 3) are sixteen jointed in the female and seventeen in the male. They are cylindrical, re-curved and thickly set with short, light-colored hairs. The first two joints are shorter and larger than the others. The succeeding joints are nearly cylindrical, close together, and equal in length, except the last, which is longer, and conical. The abdomen is lanceolate, and all the segments are freely movable on each other, so it can be easily bent beneath the body. The venation of the wings (Fig. 3) is simple, and the first discoidal cell is incomplete. We see that this parasite is a Braconid, as shown by the simple venation of the wings. The first discoidal cell is incomplete, the abdomen is lanceolate, the antennæ are sixteen or seventeen jointed, and the ventral valves in the female are simple; thus we know it belongs to the genus Aphidius. It differs from Fitch's avenaphis (see Fitch's N. Y., Report, Vol. 6, p. 98), which we also find here now, though far less in number, as that species has nineteen or twenty joints to the antennæ, is honey-yellow instead of brown, the first two joints of the antennæ and the pedicel of the abdomen, and a spot on the suture, between the second and third joints of the abdomen, are honey-yellow, and not black as in this species. The joints of the antennæ are less pedicelated than in avenaphis. If this species is undescribed, A. granariaphis would be a very appropriate name.

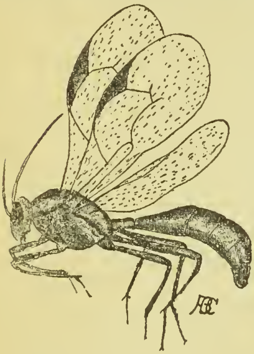


Fig. 3.—Adult female greatly magnified.

These tiny flies have been a great factor in ridding our fields of the pestiferous lice. Tiny as they are, they will save millions of dollars to the farmers of Michigan and adjacent States during this single year.

Lady-Bird Beetles.

These beautiful predaceous beetles are very active and most efficient aids in the work of ridding the grain fields of the aphides. Both as larvæ and as mature insects they feed on the plant lice, and rapidly deplete their ranks. The beautiful rounded beetles (Figs. 4, 5, 6 and 7), usually dressed in yellow or orange—we have one species (Fig. 4) which is black with orange dots—and often adorned with black dots and markings, are known and admired by all, though a few have sent me these beetles, asking if they were the Buffalo carpet beetle. Few insects do more good than do these lady-bird beetles. The larvæ of these (Fig. 7) are elongated, dark colored insects usually dotted with gray, yellow or orange, according to the species. The most common one, or at least the one most conspicuous in our wheat fields, is *Megilla maculata*. This one has a broad margin to the first joint back of the head, and two parallel lines on each side which run from above downward, of bright, beautiful orange. So the insect not only does well but looks well. There are also four rows of black dots which extend longitudinally, which are easily seen without a glass. Other species of lady-beetle larvæ are duller in color, and so less conspicuous, yet equally active and voracious. If any doubt the good work of these insects, especially the larvæ, he has but to enclose them in a box with louse infested wheat heads, or with plant lice from any plant. The rapid disappearance of the lice will

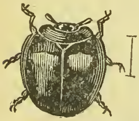


Fig 4-Two-spot Lady Beetle.

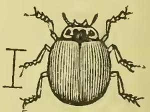


Fig. 5—Yellow Lady Beetle.

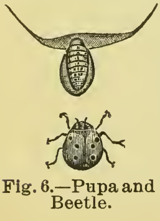


Fig. 6.—Pupa and Beetle.

quickly convince the most skeptical of the valuable service of these predaceous friends. When full grown the larvæ pupate on a straw or some blade or twig. I have in our collection a cherry twig which contains a score or more of these dark, rounded pupæ. The pupæ (Figs. 6 and 7) are exceedingly small compared with the larvæ and mature beetles. These lady-bird beetles are hardly second to the Braconid parasite, in the work of ridding our grain fields of the lice. Prof. C. M. Weed tells me that he believes in Ohio they take a first place in this important service.

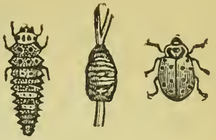


Fig. 7.—Larva, Pupa and Beetle.

The Syrphus-Flies.

By close watching in the wheat or oat fields we observe a large number of very rapid flying two-winged flies. These are not only very quick, but many are lined (Fig. 8) with yellow bands and are very beautiful. These flies, for food, only sip the sweets from flowers, but they lay their eggs on the plants among the aphides, and the maggots that hatch from these are perfect tigers. These syrphus-maggots seem to be veritable gourmands, as the number of plant-lice that one will suck bloodless is surprisingly great. These maggots (Fig. 9) look some like leeches or blood-suckers. The posterior end is large and truncated, while the mouth end is pointed. The color of the young ones is olive green, while the older or more mature maggots are gray, brown or purple. There are light brown transverse bands on the back and one longitudinal one on each side. These maggots creep along in a slug-like manner, ever reaching into every crevice for the lice. The energetic zig zag motion of the head is very interesting. When it first finds a louse it stabs him with its sharp mouth-parts and quickly sucks him bloodless. As the louse shrinks the maggot swells up. No sooner is one louse victimized before another is seized, and thus these voracious maggots will often destroy a half score of lice in quick succession. My students have often suggested that these maggots must have india rubber stomachs. From their great numbers and ravenous appetites we must conclude that these syrphus-maggots are little, if any, behind the Braconid fly and the lady-bird beetles in their good services in helping to save the grain crops.

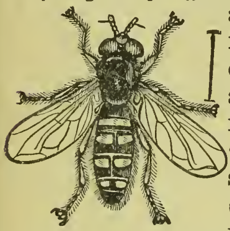


Fig. 8.—Syrphus-Fly.

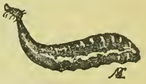


Fig. 9.—Syrphus maggot with a plant louse.

Crysopa-Flies.

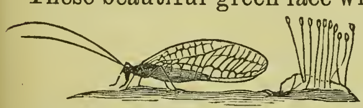


Fig. 10.—Chrysopa-Fly and Eggs.

These beautiful green lace wings, with their brilliant golden eyes (Fig. 10), are no mean factor in this warfare against plant lice. The handsome flies do not feed on the lice but the larvæ do, and as they have insatiable appetites they do excellent execution. These flies lay their minute white eggs on the ends of short hairs (Fig. 10) attached to wheat stems, twigs of fruit trees, in short to any plant that is harboring plant lice. The larvæ (Fig. 11) have strong, sharp jaws, and have well earned the name aphis-lion, which has been aptly applied to them. These and the syrphus-fly maggots work in confinement, or while we are holding the aphis infected plant in our hand. The Braconid fly and the lady-bird beetles, on the other hand, are more timid and quite easily disturbed; and so to see them at work we must approach them with care and handle them without the least jar. Thus in these beneficial insects I have described the little friends that have come to the aid of the farmer and banished disaster.

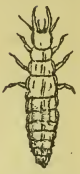


Fig. 11.
Aphis-lion.

A. J. COOK.

July 10, 1889.

NO. 52—CHEMICAL DEPARTMENT.

COMMERCIAL FERTILIZERS.

In this report of the results of analysis of commercial fertilizers offered for sale in this State during the year 1889, the law requiring inspection of such commercial fertilizers is re-printed for the information of manufacturers, dealers and the public. The law is designed primarily for the protection of the buyer, to insure a quality of goods up to the standard of the manufacturers, and to expose fraud if goods of very inferior quality are placed on the market. Incidentally the law is a protection to the manufacturer, by excluding worthless goods offered as valuable fertilizers. Honest and reliable manufacturers do not complain of this law, for the reason that while it protects the public from fraud, it also protects legitimate trade from ruinous competition with unscrupulous dealers.

The law is very direct and explicit in its terms. Every fertilizer whose retail price exceeds ten dollars a ton requires a license from each dealer, unless the manfacturer secures a license for such sale. Each separate brand of fertilizers requires a license for each year it is sold or offered for sale. It makes no difference on what kind of crop the fertilizer will be used—the farm, garden, or lawn. Nor does the law wait for the manufacturer to establish a profitable trade before it requires a license to sell.

It may seem a hardship to require a dealer who had only sold a few tons of a fertilizer to pay for a license, but the law pays no respect to the amount sold. It would be wise for dealers to inquire of the manufacturer whether he has taken out a license for each fertilizer before he accepts an agency for its sale. The very stringent provisions of section 6 of this law, imposing a fine of at least $100 for selling or offering for sale any such fertilizer without first taking out a license, should warn dealers of the danger of seeking to evade this law. A few are seeking to escape the provisions of this law to their own peril. In justice to honorable and fair dealers, the law must be enforced on all alike.

SESSION LAWS OF 1885.

[No. 26.]

AN ACT to provide for the inspection of commercial fertilizers and to regulate the sale thereof.

SECTION 1. *The People of the State of Michigan enact,* That any person or persons who shall sell or offer for sale in this State any commercial fertilizer, the retail price of which exceeds ten dollars per ton, shall affix on the outside of every package containing such fertilizer a plainly printed certificate, stating the number of net pounds therein; the name or trade mark under which such article is sold; the name of the manufacturer; the place of manufacture; and a chemical analysis, stating the percentage of nitrogen in an available form; of potash soluble in water and of phosphoric acid in available form (soluble or reverted) and the insoluble phosphoric acid.

SEC. 2. Before any commercial fertilizer is sold or offered for sale, the manufacturer, importer or party who causes it be sold or offered for sale within this State, shall file with the Secretary of the State Board of Agriculture a certified copy of the analysis and certificate referred to in section one, and shall also deposit with said secretary a sealed glass jar containing not less than two pounds of such fertilizer, with an affidavit that it is a fair sample of the article thus to be sold or offered for sale.

SEC. 3. The manufacturer, importer, or agent of any commercial fertilizer, the retail price of which exceeds ten dollars per ton as aforesaid, shall pay annually to the Secretary of the State Board of Agriculture, on or before the first day of May, a license fee of twenty dollars for each and every brand of fertilizer he offers for sale in this State: *Provided*, That whenever the manufacturer or importer shall have paid this license fee his agents shall not be required to do so.

SEC. 4. All such analyses of commercial fertilizers required by this act shall be made under the direction of the State Board of Agriculture and paid for out of the funds arising from the license fees provided for in section three. At least one analysis of each fertilizer shall be made annually.

SEC. 5. The Secretary of the State Board of Agriculture shall publish in his annual report a correct statement of all analyses made and certificates filed in his office, together with a statement of all moneys received for license fees, and expended for analysis. Any surplus from license fees remaining on hand at the close of the fiscal year shall be placed to the credit of the experimental fund of said board.

SEC. 6. Any person or persons who shall sell or offer for sale any commercial fertilizer in this State without first complying with the provisions of sections one, two and three of this act, or who shall attach or cause to be attached to any such package of fertilizer an analysis stating that it contains a larger percentage of any one or more of the constituents or ingredients named in section one of this act than it really does contain, shall upon conviction thereof be fined not less than one hundred dollars for the first offense, and not less than three hundred dollars for every subsequent offense, and the offender shall also be liable for damages sustained by the purchaser of such fertilizer on account of such misrepresentation.

SEC. 7. The State Board of Agriculture by any duly authorized agent is hereby authorized to select from any package of commercial fertilizer exposed for sale in this State, a quantity, not exceeding two pounds, for a sample, such sample to be used for the purposes of an official analysis and for comparison with the certificate filed with the Secretary of the State Board of Agriculture and with the certificate affixed to the package on sale.

SEC. 8. All suits for the recovery of fines under the provisions of this act shall be brought under the direction of the State Board of Agriculture.

Approved March 10, 1885.

At a meeting of the State Board of Agriculture held in Lansing, Dec. 1, 1885, the undersigned was appointed the agent of the Board to make the analyses of commercial manures contemplated in the foregoing act. The object of the law is to protect the purchasers and honest manufacturers, and to prevent or to punish fraud in commercial fertilizers.

The specimen for comparison of any fertilizer, with affidavit, and the fee for analysis, must be deposited with the secretary of the Board on or before the first day of May each year.

Any manufacturer or importer who desires to avail himself of the benefits of the proviso in Sec. 3, should notify me of the names of agents selling the fertilizers in this State, and the place where they are offered for sale.

Specimens for analysis will be selected in the open market, and not received from the manufacturer or his agent.

For the sake of uniformity in the certificate required in Secs. 1 and 2 to be affixed to each package of fertilizer, and to be filed with the secretary of the Board, I recommend the following form of certificate:

Name or trademark ....
Name of manufacturer..
Place of manufacture..
Net pounds in package.......................................lbs.
Analysis {
Percentage of available Nitrogen..............................
Percentage of Potash soluble in water.........................
Percentage of Phosphoric Acid soluble in water................
Percentage of Phosphoric Acid reverted........................
Percentage of Phosphoric Acid insoluble.......................
}

Any inquiries for information or communications on this subject should be addressed to

R. C. KEDZIE,
Agricultural College, Michigan.

Result of Analysis of Commercial

Manufacturer, and Place Where Made.	Trade Name of the Fertilizer.	Where the Specimen was Selected and Name of Dealer.
Cleveland Dryer Co., Cleveland, O.	Sandy Soil Fertilizer	S. B. Spencer, Holloway
Cleveland Dryer Co., Cleveland, O.	Ohio Seed Maker	S. B. Spencer, Holloway
Cleveland Dryer Co., Cleveland, O.	Potato Fertilizer	E. W. Spencer, Petersburgh
Cleveland Dryer Co., Cleveland, O.	XXX Acid Phosphate	E. W. Spencer, Petersburgh
Cleveland Dryer Co., Cleveland, O.	Buckeye Ammoniated Bone-Super-Phosphate	B. E. Niles, Blissfield
Cleveland Dryer Co., Cleveland, O.	Ammoniated Dissolved Bone	E. W. Spencer, Petersburgh
Cleveland Dryer Co., Cleveland, O.	Square Bone	E. W. Spencer, Petersburgh
Cleveland Dryer Co., Cleveland, O.	Superior Bone	E. W. Spencer, Petersburgh
Crocker Chem'l Co., Buffalo, N. Y.	Queen City Phosphate	Manufactory
Crocker Chem'l Co., Buffalo, N. Y.	Buffalo Super-Phosphate (No:2.)	Holcomb Brothers, Bay City
Crocker Chem'l Co., Buffalo, N. Y.	Ammoniated Bone Super-Phos.	Manufactory
Crocker Chem'l Co., Buffalo, N. Y.	Vegetable Bone Super-Phos.	Mich. Implement and Machine Co., Jackson, Mich.
Crocker Chem'l Co., Buffalo, N. Y.	New Rival Ammoniated Super-Phosphate	J. R. Carpenter, Blissfield
Crocker Chem'l Co., Buffalo, N. Y.	Wheat and Corn Ammoniated Phosphate	Manufactory
Crocker Chem'l Co., Buffalo, N. Y.	Potato, Hop and Tobacco Phos.	Mich. Implement and Machine Co., Jackson, Mich.
Crocker Chem'l Co., Buffalo, N. Y.	Pure Ground Bone	Manufactory
Northwest'n Fertil'g Co., Chicago	$26 Phosphate	Bialy & McDonell, Bay City
Northwest'n Fertil'g Co., Chicago	Prairie Phosphate	C. A. Slayton, Tecumseh
Northwest'n Fertil'g Co., Chicago	Garden City Super-Phosphate	C. A. Slayton, Tecumseh
Northwest'n Fertil'g Co., Chicago	Celery Grower	Stevens & Mott, Benton Harbor
Northwest'n Fertil'g Co., Chicago	Fine Raw Bone	C. A. Slayton, Tecumseh

Fertilizers in Michigan for 1889.

Composition of Fertilizers as Claimed by Manufacturer and as Found on Chemical Analysis. Percentage Estimation.

	Nitrogen.		Phosphoric Acid, P_2O_5.				Potash Soluble in Water.	
	Total Active.	Equal to Ammonia.	Available P_2O_5.		Insoluble P_2O_5.	Total, P_2O_5.	Equal to Oxide, K_2O.	Equal to Sulphate, K_2SO_4.
			Soluble P_2O_5.	Reverted P_2O_5.				
Claimed	------------	3 to 4	9	to 11	------------	10 to 13	2 to 4	----------
Found	.86	1.05	9.51	1.52	4.16	15.19	.77	1.40
Claimed	------------	1½ to 2½	10	to 12	------------	15 to 17	0	0
Found	1.12	1.36	8.31	1.08	4.28	13.67	------------	----------
Claimed	------------	4 to 5	8	to 10	------------	10 to 14	4 to 6	----------
Found	1.05	1.29	8.23	2.36	3.07	13.66	1.77	3.28
Claimed	0	0	14	to 15	------------	15 to 16	0	0
Found	------------	------------	11.51	1.49	3.16	16.16	------------	----------
Claimed	------------	3 to 4	9	to 10	------------	11 to 12	1 to 2	----------
Found	2.00	2.43	7.93	2.09	3.88	13.90	.27	.50
Claimed	------------	1½ to 2½	10	to 12	------------	15 to 18	0	0
Found	1.00	1.22	7.48	1.80	3.80	13.08	------------	----------
Claimed	------------	3 to 4	6	to 10	------------	20 to 25	0	0
Found	3.23	3.73	5.76	3.33	7.93	17.02	------------	----------
Claimed	------------	4½ to 6	0	0	------------	22 to 25	0	0
Found	3.70	4.50	------------	------------	------------	22.86	------------	----------
Claimed	------------	2 to 2½	6 to 8	2 to 4	1 to 2	9 to 14	------------	2 to 4
Found	1.86	2.26	9.38	.95	1.18	11.51	2.70	5.00
Claimed	0	0	10 to 11	1 to 2	1 to 2	12 to 15	1 to 2	2 to 4
Found	------------	------------	11.80	2.91	2.51	17.22	1.35	2.50
Claimed	------------	3½ to 4½	10	to 12	1 to 2	11 to 14	------------	2 to 3
Found	3.33	4.05	9.22	2.42	2.14	13.78	1.80	3.33
Claimed	5 to 6	6 to 7	6	to 7	1 to 2	7 to 9	6 to 8	11 to 15
Found	3.92	4.76	3.67	1.57	2.4	7.64	7.40	13.70
Claimed	------------	1½ to 2½	10	to 12	1 to 3	11 to 15	------------	3 to 5
Found	1.75	2.12	8.31	.92	1.57	10.80	1.96	3.63
Claimed	------------	2½ to 3½	10	to 13	1 to 2	11 to 15	------------	3 to 5
Found	2.42	2.94	5.92	3.84	1.91	11.67	2.73	5.05
Claimed	------------	2½ to 3½	10	to 12	1 to 2	11 to 14	------------	6 to 8
Found	1.94	2.35	8.87	1.87	1.76	12.50	3.90	7.44
Claimed	------------	3½ to 4	0	0	------------	25.	0	0
Found	4.75	5.76	------------	------------	------------	25.40	------------	----------
Claimed	------------	1½ to 2	6	to 8	7 to 9	13 to 17	0	0
Found	2.40	2.90	5.60	5.59	4.32	15.51	------------	----------
Claimed	------------	1½ to 2	6	to 8	9 to 11	15 to 19	0	0
Found	1.71	2.08	4.80	5.06	5.41	15.27	------------	----------
Claimed	------------	2¼ to 3	4 to 4½	4 to 4½	2 to 3½	10 to 12½	.54 to 1.08	----------
Found	2.25	2.73	5.83	1.79	4.64	12.26	.48	.90
Claimed	------------	3 to 4	7	to 9	------------	------------	------------	2 to 3
Found	2.87	3.48	4.64	2.75	6.20	13.59	1.48	2.74
Claimed	------------	3 to 4	0	0	------------	23 to 25	0	0
Found	3.80	4.60	------------	------------	------------	24.54	0	----------

Results of Analysis of Commercial Fertilizers

Manufacturer, and Place Where Made.	Trade Name of the Fertilizer.	Where the Specimen was Selected and Name of Dealer.
Michigan Carbon Works, Detroit	Homestead Super-Phosphate	Warehouse of Manufacturer
Michigan Carbon Works, Detroit	Jarves Drill Phosphate	Warehouse of Manufacturer
Bradley Fertilizer Co., Boston, Mass.	Bradley's Dissolved Bone with Potash	T. J. Sutton, Sutton
Bradley Fertilizer Co., Boston, Mass.	B D Sea Fowl Guano	T. J. Sutton, Sutton
Lister's Agr'l Chemical Works, Newark, N. J.	Lister's Success Phosphate	Davis Brothers, Jackson, Mich.
Walton & Whann Co., Wilmington, Del.	Diamond Soluble Bone	S. M. Isbell & Co., Jackson
Walton & Whann Co., Wilmington, Del.	Diamond Soluble Bone and Potash	Manufacturer
W. S. Dunbar, St. Joseph, Mich.	Fish Fertilizer	Manufacturer
W. S. Dunbar, St. Joseph, Mich.	Bone and Meat Fertilizer	Manufacturer
The Farmer's Fertilizer Co., Detroit, Mich.	Farmers' Fertilizer	Samuel Kerr & Co., Detroit
Anti-Kalsomine Comp'y, Grand Rapids, Mich.	Church's Bug Finish	Manufacturer
Western Union Chemical Co., Cleveland, O.	Empire Super-Phosphate	Manufacturer
Western Union Chemical Co., Cleveland, O.	International Super-Phosphate	I. W. Hicks, Richmond
Northwestern Chemical Co., Milwaukee, Wis.		John Muller, Warren
Western Reserve Fertilizer Co., Mineral Ridge, O.	Western Reserve Fertilizer	P. J. Abfalter, Lansing

in Michigan for 1889.—CONTINUED.

Composition of Fertilizers as Claimed by Manufacturer and as Found on Chemical Analysis. Percentage Estimation.

	Nitrogen.		Phosphoric Acid, P_2O_5.				Potash Soluble in Water.	
			Available P_2O_5.					
	Total Active.	Equal to Ammonia.	Soluble P_2O_5.	Reverted P_2O_5.	Insoluble P_2O_5.	Total, P_2O_5.	Equal to Oxide, K_2O.	Equal to Sulphate, K_2SO_4.
Claimed. Found...	1.85 to 2.40 2.46	2.25 to 3.15 2.99	7 to 10 7.65	1 .37	.50 to 1.50 2.24	8.5 to 11.5 10.26	.... 1.68	2.75 to 3.50 3.10
Claimed. Found...	.... 1.16	1¼ to 2 1.41	7 to 8 7.14	½ to 1½ 1.33	2 to 3 2.27	10 to 12 10.74	0 0	....
Claimed. Found...	.... 1.13	1 to 2 1.38	6 to 8 8.63	2 1.09	.... 2.43	10 to 12 12.15	.... 1.94	4 to 6 3.60
Claimed. Found...	.... 2.17	2.5 to 3.5 2.63	6 to 8 8.63	2 1.77	.... 2.40	10 to 12 12.80	1.5 to 2.5 1.12	2.75 to 4.75 2.08
Claimed. Found...	.... 1.65	1¼ to 2 2.17	10.50 7.75	to 12.00 1.44	.... 4.64	.... 13.83	.... 1.15	1½ to 2 2.12
Claimed. Found...	.... .35	½ to 1 .43	13 9.11	to 15 2.84	1 to 3 3.95	14 to 18 15.90	0	0 ....
Claimed. Found...	0	0	13 8.00	to 15 .40	1 to 3 7.35	14 to 18 15.75	2¾ to 3¼ 2.36	.... 4.40
Claimed. Found...	6.75 5.67	8.19 6.88	0	0	....	14.00 13.78	0	....
Claimed. Found...	6.24 4.78	7.58 5.80	0	0	....	16. 14,52	0	....
Claimed. Found...	.... 2.45	2½ to 3¼ 2.97	.... 2.02	.... 1.60	.... 1.05	8 to 11 4.67	.... .54	2¾ to 3½ 1.00
Claimed. Found...	0	0	....	....	....	? .10	0	0 ....
Claimed. Found...	....	1¼ to 2½ 1.83	9 10.09	to 12	3 to 5 4.09	12 to 17 14.18	0 0	0 0
Claimed. Found...	0 0	0 0	12 12.80	to 14	2 to 4 3.20	14 to 18 16	0 0	0 0
Claimed. Found...	....	2.63 2.52	8 6.75	to 10	.... 5.75	.... 12.50	....	1 to 2 trace
Claimed. Found...	0 0	0 0	....	trace trace	to	2.00	trace	to 2.00 .23

NO. 53.—ENTOMOLOGICAL DEPARTMENT.

SPRAYING WITH THE ARSENITES.*

Mr. President—

Nine years ago, at the first meeting of this society, I presented a paper upon the use of Paris green as a specific against the codling moth.

In that paper I gave the results of careful and elaborate experiments, which settled two facts that were very important in economic entomology: First, that Paris green was efficient as a preventive of the ravages of the codling larva; and secondly, that such use was entirely safe in respect to poisoning the fruit. Today, less than a decade from the date of the discovery of this remedy, this method to combat the worst insect pest of the apple grower is generally adopted by the more intelligent orchardists of our country. Its value is now universally conceded. Easy and cheap methods to apply the insecticide are now known and generally adopted.†

For several years myself and others have been experimenting, in hopes to find that this same insecticide was equally efficient to destroy the plum curculio. For six or seven years I have sprayed plum trees once and even twice with no apparent good. Test trees, close beside the trees sprayed, and that were not treated, were as free from attack as were the trees that were sprayed, and the trees treated were no more exempt from attack than the others. Thus I was convinced that this insecticide was of no value in this curculio warfare. Several of my horticultural friends, in whose ability to experiment and observe correctly I had great confidence, had tried this remedy with *very satisfactory* results. In 1888 I studied this matter very closely, and concluded that as the plum is a smooth fruit, with no calyx cup like that of the apple, in which the poison may lodge, and as the curculio lays its egg anywhere on the smooth rind, the poison would be very easily washed off, or even blown off by the wind. I thus concluded that my want of success was very likely due to a want of thoroughness. In 1888 I sprayed certain trees three times, at intervals of eight days, and omitted to treat other trees close alongside. The benefit from spraying was very marked.

I also found that carbolized plaster—one pint of crude carbolic acid to fifty pounds of plaster—was quite as efficient to repel the curculio as was the arsenites. This was also applied three times. The season was very dry, and there were few or no rains to wash off the insecticides. This year I repeated the experiments both with the London purple and with the carbolized plaster, but with no success. All the trees were severely attacked, and all the plums lost. This year we had almost daily rains, which were frequently quite severe.

---

* Read at Toronto, August 26, before the Society for the Promotion of Agricultural Science.

† A very cheap and excellent pump, not mentioned in Bulletin No. 39, issued by the Michigan Experiment Station, of last year, is the Brooks Brass Hand-force Pump, and is sold for $2.00, by Mr. J. K. Compton, Leslie, Michigan. For a few trees it serves very well.

I believe I am warranted in the following conclusions: The arsenites and carbolized plaster will protect against the plum curculio if they can be kept on the tree or fruit. But in case of very frequent rains the jarring method will not only be cheaper, but much more effective. Again, as our wild fruits are more cleared away we must have plums in our orchards to protect the apples from the curculio. When apples are seriously stung they become so gnarled and deformed as to be worthless. It will pay, then, to set plum trees near by or among the apple trees. Then we will escape mischief among our apples from the curculio, and will only need to spray our apples once, to destroy the codling moth, and can treat the plum trees three or four times with Paris green or carbolated lime in case we have only occasional showers, or can jar the trees when the rains are very frequent. For the apples we can use London purple, one pound to 200 gallons of water. For the plums we must use Paris green, one pound to two or three hundred gallons of water. If the carbolated plaster is preferred, we use one pint of crude carbolic acid to fifty pounds of land plaster. This is thrown freely over the trees, so as to strike every plum on the tree which is being treated.

Another very important practical point has been suggested by the past season's experience with these insecticides: I refer to the danger of applying them before the blossoms fall. Bees are quite as susceptible to these poisons as are the codling larvæ and curculio. In their good work of collecting nectar and fertilizing the blossoms, they are very certain to take the poison as well, if the trees have been sprayed. Of course there is no excuse for spraying at so early a date, as neither the curculio or codling larvæ commence their attack till the blossoms fall. Thus for the object in mind, as well as for the safety of the bees, delay should be insisted upon. I think we, as scientists and all educated men, should pronounce vehemently and with one voice against spraying our fruit trees with the arsenites till the blossoms have all fallen. We should even go farther. We should secure the enactment of laws which would visit any such offense with fine and imprisonment. Such laws would prove a ready and active educator.

In the past season many bee keepers have lost severely from the neglect of their fruit growing neighbors to observe this caution. I will only mention two cases. Mr. John G. Smith, Barry, Illinois, writes: "One of my neighbors, owning an orchard of about one hundred acres of apple trees, sprayed the trees with Paris green and water just as they were in full bloom. The result is that ten or twelve bee keepers are ruined." The imago no less than the larvæ and pupæ were destroyed. Mr. J. A. Pearce, Grand Rapids, Mich., was also a heavy loser from the same cause. His bees likewise died in all stages of development.

It is well to remember and to urge that this loss is not confined to the bee keeper, for the fruitgrower as well as the apiarist needs the bees and their work to insure his best success. It only requires, then, that our people know the truth to insure against loss in this direction.

INJURY TO THE FOLIAGE.

Another practical question of no small moment in this use of the arsenites refers to injury to the foliage of the trees treated. In an elaborate series of experiments the past season, we desired to learn the effect on different trees of the different arsenites, and whether the date of treatment and atmospheric condition had any influence. The following is a tabulated statement of the experiments:

Date.	Variety Treated.	Poison Used.	Date of Second Application.	Time after Treatment	Weather.	Effect.
May 20..	6 plum trees...	Lon'n p'ple 1 lb. to 200 gal.	June 5....	Ten days	Rain 21, 23	No injury.
May 20..	2 cherry trees..	“ “ “	“	“	“	“ “
May 21..	4 apple “	“ “ “	May 23....	“	“	“ “
May 23..	5 cherry “	“ 1 lb to 150 gal.	“	“	“	“ “
June 7...	3 willow “	“ 1 lb to 100 gal.	June 12...	“	....	“ “
June 7.	3 elm “	“ “ “	“ ...	“	....	Some.
June 7...	3 h. maple “	“ “ “	“ ...	“	....	“
June 7...	5 apple “	“ “ “	“ ...	“	....	“
June 7...	5 cherry “	“ “ “	“ ...	“	....	None.
June 7...	5 plum “	“ “ “	“ ...	“	....	Some.
June 12..	3 elm “	“ “ “	June 17...	“	....	Much.
June 12..	3 plum “	“ “ “	“ ...	“	....	“
June 12..	3 apple “	“ “ “	“ ...	“	....	“
June 12.	3 cherry “	“ “ “	“ ...	“	....	None.
June 24..	3 apple “	“ “ “	....	“	Rain 25th	Very bad.
June 24..	3 peach “	“ “ “	....	“	“	“ “
June 24 .	3 plum “	“ “ “	....	“	“	“ “
July 5...	5 peach “	“ 1 lb. to 200 gal.	....	Five days	....	Great injury.
July 8...	2 peach “	“ “ “	....	“	....	“ “
July 8...	1 cherry “	“ “ “	....	“	....	Slight.
July 8...	1 pear “	“ “ “	....	“	....	Some.
July 10..	1 pear “	“ “ “	....	“	....	“
July 10..	3 peach “	“ “ “	....	“	....	Very bad.
July 10..	1 plum “	“ “ “	....	“	....	Quite bad.
July 11..	2 peach “	Paris gr'n, 1 lb. to 100 gal.	....	“	....	Slight.
July 11..	2 peach “	“ 1 lb. to 200 gal.	....	“	....	None.
July 11..	2 peach “	“ “ 250 gal.	....	“	....	“
July 11..	2 peach “	“ “ 300 gal.	....	“	....	“
July 11..	2 peach “	London purple water......	....	“	....	Great injury.
July 15..	3 peach “	W'te ars'ic 1 lb. to 300 gal.	....	“	....	“ “
July 15..	3 peach “	Lon'n p'ple 1 lb. to 200 gal.	....	“	....	“ “
July 15..	3 peach “	Solution analine..........	....	“	....	None.

I think we are warranted in the following conclusions: First, London purple is more injurious to the foliage than is Paris green; and white arsenic—aresenious acid—is more harmful than is either London purple or Paris green. This is doubtless owing to the soluble arsenic which is quite abundant in London purple, and almost absent in Paris green. In experiment No. 29 (See table) it will be noticed that the colored water after London purple fully settles is very destructive to foliage, while analine (See experiment No. 32) is not at all harmful. This agrees with the experiments of Prof. C. P. Gillette, made in 1888, where white arsenic was found very destructive to foliage.

Secondly, Peach foliage is especially susceptible to injury, and cherry foliage the least so of any of the kinds treated.

Thirdly, It would seem that London purple and white arsenic, used just before a rain, are more harmful than when used during a drought. We not only saw greater injury when a rain followed spraying within two or three days, but secured the same results by spraying, soon after treatment, with pure water. This also accords with the view that the injury comes from the presence of soluble arsenic.

Fourthly, It would seem that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or better, a few weeks. For ten years I have sprayed both apple and plum trees in May, and for several years with London purple, and often used a mixture as strong as one pound to one hundred, or even fifty gallons of water. Yet in most cases no damage was done. This year I sprayed several trees in May, using one pound to 100 gallons of water with no damage. In June and July spraying the same trees with a mixture only one-half as strong did no slight injury. This fact, if fact it be, accounts for the few reports of injury in the past, even with a stronger mixture, and the frequent reports of damage within a year or two, even with a dilute mixture. Then the spraying was confined to May; now it reaches to June, or even to July.

Fifthly, London purple may be used on apple, plum, cherry, pear, and most ornamental trees, but on these should never be stronger than one pound to two hundred gallons of water. If the application is to be repeated, as it must be for the curculio, to prove effective, or if it is to be used in June or July, Paris green should be used, in the same proportion as above, or else we should only use one pound of London purple to three hundred gallons of water. I now think that this necessity is more due to time of application than to the fact of increased quantity of the poison.

Sixthly, If the arsenites are to be used on the peach, to defend against the curculio, Paris green only should be used, and that not stronger than one pound to three hundred gallons of water. With the peach the poison is not only absorbed, coloring the tissue purple or brown, but even the petiole or stem of the leaf is weakened, and the leaf falls. Thus in several cases where we used London purple, one pound to two hundred gallons of water, or white arsenic, the peach leaves all fell off. White arsenic colors the tissue the same as does the London purple, showing once more that it is the soluble arsenic, not analine, that does the mischief.

Seventhly, The injury done to the foliage is never immediately apparent. It usually shows somewhat the second day, but the full injury is frequently not manifest till the fifth day, and often not till the tenth.

POISONING THE PASTURE UNDER THE TREES.

Another important practical question which I have tried to settle this season—1889—concerns the danger of pasturing under trees which have been sprayed with the arsenites.

A gentleman wishing to spray his orchard, in which he was pasturing seventy-five hogs, consulted me as to the wisdom of doing so without first removing the swine. I told him I believed there was no danger. I said use a mixture, one pound of London purple to two hundred gallons of water, watch your hogs closely and if any seem affected remove all at once, and I will be responsible for damages to the amount of twenty-five dollars. The gentleman did so and reports no damage.

In the following experiments I used the mixture of twice the strength which should be used, that the experiments might be the more convincing. I used one pound to one hundred gallons of water. In every case the spraying was very thoroughly done. Care was taken that every twig and leaf should be drenched.

In tree No. 1 a thick paper was placed under one-half of a rather small apple tree. The space covered was six by twelve feet, or seventy-two square feet. The paper was left till all dripping ceased. As the day was quite windy the dripping was rather excessive. In this case every particle of the poison that fell from the tree was caught on the paper. Dr. R. C. Kedzie analyzed the poison and found four-tenths (.4) of a grain. Tree No. 2 was a large tree with very thick foliage. Underneath this tree was a thick carpet of clover, blue grass and timothy just in bloom. The space covered by the tree was fully sixteen feet square, or equal to two hundred and fifty-six square feet. As soon as all dripping had ceased, the grass under the tree was all cut very gently and very close to the ground. This was taken to the chemical laboratory and analyzed by Dr. R. C. Kedzie. There was found 2.2 grains of arsenic. Now, as our authorities say that one grain is a poisonous dose for a dog, two for a man, ten for a cow, and twenty for a horse, there would seem to be small danger from pasturing our orchards during and immediately after spraying, especially as no animal would eat the sprayed grass exclusively. To test this fully, I sprayed a large tree over some bright tender grass and clover. I then cut the clover carefully, close to the ground, and fed it all to my horse. It was all eaten up in an hour or two, and the horse showed no signs of any injury. This mixture, remember, was of double the proper strength, was applied very thoroughly, and all the grass fed to and eaten by the horse. This experiment was repeated with the same result. I next secured three sheep. These were kept till hungry, then put into a pen about a tree under which was rich, juicy June grass and clover. The sheep soon ate the grass, yet showed no signs of any injury. This experiment was repeated twice with the same result. It seems to me that these experiments are crucial and settle the matter fully. The analyses show that there is no danger, the experiments confirm the conclusion.

Thus we have it demonstrated that the arsenites are effective against the codling moth, that in their use there is no danger of poisoning the fruit, and when used properly no danger to the foliage, nor to stock that may be pastured in the orchard.

A. J. COOK.

August 17, 1889.

NO. 54.—BOTANICAL DEPARTMENT.

EXPERIMENTS AND OBSERVATIONS ON THE JACK-PINE PLAINS.

At the close of the second growing season of the plats at the experiment stations on the sandy plains, pressing inquiries are made as to "what are the prospects so far as you have gone?"

Perhaps unwisely, I venture to offer this bulletin on the subject, though it is too soon to attempt to give very decided results.

Most of the work so far done has been undertaken with the view of obtaining some clues for making more extended and thorough experiments. The tests so made are mostly crude, indefinite, and lack exactness. I have no specific data founded on exact weights and measurements.

My former report to the Director of the Experiment Station, not yet printed, contains some statements which would be interesting in this connection.

Owing to the distance from the College, and the time and expense required, I have only visited the stations all around four times in 1888, and three times in 1889. Could the plats be seen oftener, and could more careful oversight of the labor be secured, I might have made more rapid progress in some directions.

In many respects, none of us know just what are the most promising experiments. We are doing some preliminary work, and must, for the sake of economy, take a little time to learn the best course to pursue.

At the close of the first summer, I should have judged that the common locust was the most promising tree to attempt to grow on the sands of Northern Michigan, but after six months of winter, when nearly every tree was dead, root and branch, I must change my opinion. Other illustrations could be given.

No two seasons are exactly alike, and over these we have no control. Cutworms in one place, as at Grayling last spring, may devour nearly all the growing crops, but not be very troublesome in most other parts of the State. Hence the wisdom of trying similar experiments in several different parts of the State. An accident may occur in conducting one experiment, but if others are performed as intended, results may be reached.

With this explanation, I will venture to give some opinions as to the probable meaning of the tests so far made, though time may show that mistakes have been made. I make no promise to adhere to opinions here expressed with a view to being consistent.

The opinions given are based on the experiments I have made during the past two years, on some things observed with reference to experiments made at Grayling by my colleague, Dr. Kedzie, on answers to inquiries put to many persons in various parts of the State, and on observations made in many places.

It will be remembered that I am making experiments at Oscoda, Iosco county; Grayling, Crawford county; Baldwin, Lake county; Walton, Grand Traverse county, and Harrison, Clare county.

At Grayling the results so far attained with young forest trees are given in my last report for June, 1889. At this station I have tried for one year, or in many cases for two years, a very large number of kinds of grasses and other forage plants on small plats a rod square. These tests were made on land which had been cropped for several years, without much, if any, fertilizing. At Harrison, for one year, I tried about a quarter of an acre of each, in 1888, of spurry, rye, sweet clover, peas, alsike clover, red clover, mammoth clover, alfalfa, perennial rye grass, Italian rye grass, meadow fox-tail, orchard grass, tall oat grass, Timothy, Hungarian grass, German millet, June grass, meadow fescue, a mixture of one-fourth acre of tall oat grass and orchard grass; another of perennial rye grass and mammoth clover; another of orchard grass and mammoth clover; another of a mixture of mammoth clover, red clover, alsike clover, tall oat grass, orchard grass, perennial rye grass, June grass, meadow fox-tail and Timothy.

The above tests at Harrison were made on land which had been successively cropped for six years, without manure or seeding to grass or clover.

These tests at Grayling and at Harrison, added to what I have learned from many other sources, satisfy me that it is a hopeless task to attempt to find any grass or other forage crop, any grain or fruit or vegetable which can be *profitably* grown without the aid of some fertilizer. An exceptionally favorable season might now and then be found, at wide intervals, when such crops might do very well, but they could not be relied on for profitable farming.

On such land, to produce anything worth while, some fertilizer or irrigation I believe to be indispensable. I am not yet prepared to say what fertilizers would prove most profitable, or whether, even with fertilizers, there would be a profit.

The above statements are not intended to apply at present to new land just broken up, or land which has been generously treated. The quality of the land selected for experimenting may be graded about as follows: Oscoda poorest, then that at Grayling, then Walton and Baldwin much alike, Harrison best of all.

The land of each station is jack-pine plains, and may safely be graded as thin, light, or poor, in the ordinary acceptance of these terms. The botanist finds the smallest number of species of wild plants growing on the poorest land; for example, a smaller number on the plats at Oscoda than on those at Harrison.

On the land newly broken, in the spring of 1888, at Oscoda, Walton, Baldwin and Harrison, the size of the plats and the seeds sown on each are essentially a repetition of each other; the seeds are the same as those above named as sown on the old field at Harrison.

It is very interesting to watch these experiments. Something new occurs to me on every visit; as to what to sow, the modes of sowing, time of sowing, modes of cultivating and treatment of the land.

PLATS AT WALTON.

Below a plan of the plats is shown as made in the spring of 1888. The land had been cleared and fenced. It was well plowed and harrowed and rolled; the rolling was done after the seeds were sown. The land appears to be of even quality, and is nearly level. From May 7 to August 4, 1888, was a very dry season; the spring of 1889 was moister and favorable for the starting of seeds. During the year 1888 no fertilizers of any kind were used. The eight sorts sown in three places were fowl meadow grass, orchard grass, Timothy, tall oat grass, perennial rye grass, meadow foxtail, red clover, and mammoth clover.

27.—Blank. Plowed not sown.	26.—Hungarian. Sown about May 20. Sown to red clover late in Aug.	25.—Rye. Sown about May 20. Sown to red clover late in August.	9.—Left wild.
24.—Meadow fescue. Sown about May 20.	23.—Millet. Sown about May 20. Sown to red clover late in August.	22.—Alfalfa. Sown about May 20.	
21.—Alsike clover. Sown about May 20.	20.—June grass. Sown May 11.	19.—Eight sorts. Sown May 11.	
18.—Timothy. Sown May 11.	17.—Italian rye grass. Sown May 11.	16.—Spurry. Sown May 11.	
15.—Perennial rye grass. Sown May 11.	14.—Meadow foxtail. Sown May 11.	13.—Field peas. Sown May 11. Sown to orchard grass late in August.	
12.—Mammoth clover. Sown May 11.	11.—Red clover. Sown May 11.	10.—Sweet clover. Sown May 11.	
8.—Orchard grass. Sown May 11.	7.—Tall oat grass. Sown May 11.	6.—Orchard grass. Sown May 11.	5.—Unplowed, not harrowed. Seven sorts. Sown May 11.
4.—Orchard grass. Sown May 11.	3.—Tall oat grass and orchard grass. Sown May 11.	2.—Mammoth clover and orchard grass. Sown May 11.	1.—Unplowed, but harrowed. Seven sorts. Sown May 11.

On October 18, 1888, the following notes were made: No. 1, a very little small grass seen; No. 2, rather small, mostly thick enough, two or three inches high; No. 3, nice and even, though short; Nos. 4, 6, 8, look well, three inches high; No. 5, nothing seen of seeds sown; No. 7, thin, spotted, slim, some stems six inches high; No. 9, left without cultivation; No. 10, pale, thin, large roots; No. 11, a poor catch, some of it has gone to seed; No. 12, thicker and better than red clover; No. 13, a very small crop left and land sown to orchard grass late in August; No. 14, exceedingly thin, a very poor catch, probably the seed was poor; No. 15, better than Timothy, none with flowering stems; No. 16, thick, one foot high, freely seeding, some seed sprouting on the ground; No. 17, better than perennial rye grass, some of it has seeded; No. 18, Timothy thin and very light, no stems with spikes; No. 19, thick, even, not quite so large as some; No. 20, none seen; No. 21, appears too thin, must be seeded over; No. 22, spindling, very stout roots, hard to pull by hand, thin, promising; No. 23, very thick, some of it one and a half feet high, much of it eight inches; No. 24, scattering, some good patches; No. 25, thin, two and a half feet high, spikes short; No. 26, about like the German millet.

The rye, Hungarian and millet were cut and taken off. The clover sown on that ground was not harrowed. Wild sweet ferns and brakes and other wild plants were rather common all over the plats.

The following operations were performed in 1889: In April, a thick top-dressing of good old barnyard manure was spread on the east end of each plat, extending over a space about twenty feet square. At the same time two quarts of Homestead superphosphate was sown on a similar space near the middle of each plat. Number 7 was reseeded with tall oat grass, number 14 was seeded to red clover, number 18 was reseeded to Timothy, meadow fescue was reseeded on number 24, alsike clover seeded on number 21, June grass on number 20. Number 27 was harrowed, sown to red clover and rolled. On July 11 a strip of new land two rods wide along the east end of the plat was broken up as shallow as it could well be plowed. The intention is to backset it and seed in spring. In October, when visited, this piece was quite clean, only a few wild plants having grown up through the furrows.

On October 16, at the close of the second growing season, the following notes were taken:

The spring was very dry till near the end of May, but wet and cool in June, favorable for young grass and clover. Where the seven sorts were sown two years ago, without harrowing or plowing, there is rarely anything to show for it. The seed sown where the new land had simply been harrowed is coming on quite well, as though in time it might amount to something. Those most prominent are orchard grass, oat grass, Timothy and the clovers. Number 2, mammoth clover and orchard grass sown a year ago last spring, well seeded, clover making the most show, excepting where the barnyard manure was spread; there the orchard grass has made the most progress and crowded the clover. In all cases, so far as can be seen, the barnyard manure helps the true grasses more than it helps the clovers, while the superphosphate has helped the clovers more than the true grasses. The benefit of superphosphate to the clover is very marked and unmistakable. Number 3, tall oat grass and orchard grass: the manure helps; can't see as superphosphate has been any benefit; a very good show, two to three feet high. Both have seeded and the seed has fallen and is coming up in places. This is better than a plat next to it where tall oat grass was sown alone. Numbers 4, 6, 8, orchard grass: Short; the manure helps it; can't see as superphosphate did; not very many stems have gone to flower and seeded. Number 7, tall oat grass: Mostly sown a year ago last spring; rather thin, not so good as where something else is sown with it. Number 10, sweet clover: This was eaten by cut worms in spring, as I suppose other plants were to some extent; the plants are very scattering, slim, two feet or more high, seeded, now nearly all dead; this plant is of no account so far as I can see. Number 11, red clover sown a year ago last spring: There is not so much on the ground as where orchard grass or tall oat grass were added; not so promising as mammoth clover. Number 12, mammoth clover: Manure has helped it considerably; superphosphate still more. Number 13, orchard grass, sown in August of 1888, after peas, without harrowing or rolling, nearly a failure; no show: Number 14, meadow foxtail: A little scattering; two and one-half feet high on the east end; seed ripened and fallen and growing; most of plat is too thin to be of any value; this is the great trouble with meadow foxtail everywhere; the seeds are often poor, or the chaff fails to fill. Number 15, perennial rye grass: Even, rather thin, twenty inches high, seeded, seed fallen and now coming up; manure helps it. Number 16, spurry: In spring, patchy, very small; manure helps it; in October, nearly all gone; little in sight; of no account. A similar statement may be made of the plats in Oscoda and Baldwin. Number 17, Italian rye grass: Pretty good, better than rye grass; two feet high; seeded; fallen seeds growing; the old plants may be expected to all die this winter; we shall see. Number 18, Timothy: Thin; two and one-half to three feet high; seeds have fallen and are growing. Number 19, a mixture of eight sorts noted above: Thicker than any other plat; well seeded, even; manure helps grasses some; superphosphate the clovers. Number 20, June grass: But very little seen; of the first seeding some has seeded. This grass has so far in other places only caught in a very few spots. Number 21, alsike clover: Stems spreading or bending over; covered with bees in June; a very good show, taking the eye of visitors as well as anything; weeds not so plenty here as in most other places; plants really are rather thin; seeding very freely; manure helps it, superphosphate helps it still more. After all the show, I question whether mammoth clover and orchard grass or this clover in other mixtures would not yield more hay. Number 22, alfalfa or lucerne: Spindling, with narrow tops and stout roots; ten to twelve inches high; rarely any went to seed; the plat is very weedy; it doesn't so far look as though it would be worth much, for the cold, short summers of this part of the State. The same may be said of the plats at Baldwin and Oscoda. Numbers 23–26, red clover sown late in August of 1888, after German millet and Hungarian grass: Mostly failed to catch; in Oscoda this plan worked with great success. Number 24, meadow fescue: Rather thin; two and one-half to three feet high, and pleases all who see it; apparently better than Timothy; manure benefits it; the seeds have fallen and are growing in open places nicely. Number 25, red clover, sown late in August of 1888 after rye; A little rye now seeded; hardly any clover. In Oscoda this plan was a success. Number 27, plowed and left vacant during 1888, sown to red clover this spring and rolled: Came up thick, but was mostly killed by frost later; now very little seen.

The seeding on new land at Harrison this spring all caught first rate and now stands thick on the ground.

HOW TO MANAGE THE LIGHT SANDY LANDS.

Much study and experimenting should be given the subject to learn what are the cheapest and best methods of management. I do not yet pretend to know what is the best course to pursue in all cases.

In the land itself there is little capital invested, but it is very easy to spend a good deal of work with team and men, which, added to the first cost of land, should, to be profitable, sooner or later all give ample returns for the investment.

I am experimenting on two plans for getting rid of the oak grubs, one by taking them out, root and branch; the other by thoroughly chopping down clear to the grub itself, all the sprouts, late in July or early in August.

I have so far done most of the breaking in spring, but I am inclined to think that a better plan is to plow shallow in July or August, and "backset" it a little deeper in the following spring for seeding. As a rule, a shrub or tree is most easily killed by disturbing it or injuring it while it is in the midst of a summer's growth. If plowed late in autumn or early in spring, the buds, rootstocks and roots contain much starch stored up ready to push new sprouts on the approach of warm weather.

The land is light and should be rolled. Probably no outlay will pay better than rolling the land in connection with seeding. It presses the particles of soil closer together and brings them closely in contact with the seed. It is one of the peculiarities of these sands, that they do not readily retain moisture; packing the land aids it in retaining moisture.

The ordinary spring-toothed harrow so much used is in my opinion one of the poorest and most unsatisfactory implements that can be used on these sandy lands, especially when new, before the tough roots have decayed. They pull the roots out, disturbing the furrows, requiring considerable labor to get rid of them.

The roots are an advantage to the soil when decayed. If a light slanting-toothed harrow is used the roots will be little disturbed and the surface will be made ready for fine seeds. Give some attention to cutting out the roots of large wild perennials, which the plowing did not kill.

I would not start on this new land with a crop of millet or Hungarian grass. They are exhaustive crops and too easily damaged by frost. Neither would I try potatoes, buckwheat, oats, wheat or corn. If rye is used I should mow it often enough to prevent its seeding, or perhaps plow under when full grown.

So far as I can learn, a mixture of three or more kinds of grasses and clovers occupy the soil more completely and give a better yield than any one kind. The best of these, in my opinion, are mammoth clover, alsike clover, tall oat grass, orchard grass, tall fescue, Agropyrum tenerum (a wild grass from the west), and Timothy; the last perhaps the poorest of all for these sands. From my experience it will take three or four years to secure a good covering of the sands by June grass or meadow foxtail. Red clover is likely to die at the close of the second year, and make it necessary to plow or harrow or in some other way to reseed.

To seed down a new piece of such land, as it is light and the season short, is a slow and rather expensive process. If the seeds of grasses and clovers are started with those of rye, oats or wheat, the catch is likely to be a poor one, and even when sown without another crop, they make only a small growth the first short season. I prefer perennial grasses and clovers to those which are likely to perish in one or two years.

As the process of seeding down is often only partially successful on the first year, if the plants are perennial, we can add more seed here and there and roll the land, thus patching up the thin or vacant spots. Again, the perennial grasses and clovers may be allowed to mature seed which will scatter over the ground and help fill up the vacancies. After the land is pretty well covered with a good growth it may be mowed once only, rather early, and not pastured, or if not mowed, pastured only slightly, allowing the plants to keep plenty of leaves for a good growth. After four or six years, the turf may be plowed and a orop of potatoes, oats, peas, buckwheat or wheat taken off, and the land reseeded after the crop is taken off, and remain again seeded for several years.

Aim from the start to keep the land improving by generous treatment. I am inclined to believe that it will be found best in the long run, to add some fertilizer every year, for a time at least, probably superphosphate for clovers and the like, and something else to help the grasses proper, using every speck of barnyard manure than can be found. In the latter case, the subject of carefully husbanding the supply should be well understood, not forgetting that most of the urine of animals is usually lost, although it is of nearly as much value as a fertilizer as are the solid excrements. Some kinds of muck are worth experimenting with.

The poor homesteader, above all others, should understand the principles of agriculture if he expects to succeed on these lands. If he has to depend for his living from the start on what he can dig out of the soil and has no other business to help him, the plains are no place for him.

To manage the sandy plains well and most profitably, if it can be done at all, can best be done by men who have capital, by men who can afford to labor and to wait. If success come at all, it will ultimately come with a generous treatment of the soil from the very start. The land can either be subdued and improved a little piece at a time by the poor man who has a good piece of land to live on, or by the capitalist who may undertake the improvement of large areas.

Finally, do not place too much confidence in some of the suggestions here made, as future and more extended experiments may show that some of them are ill-advised.

W. J. BEAL,
Botanist of the Experiment Station.

AGRICULTURAL COLLEGE, MICH.,
Nov. 1, 1889.

NO. 55—HORTICULTURAL DEPARTMENT.

NOTES ON FRUIT TESTING AT THE SOUTH HAVEN SUB-STATION,

BY T. T. LYON.

In response to the earnest requests of the fruit growers along the eastern shore of Lake Michigan, the Board of Agriculture authorized the establishment of a sub-station, for the purpose of testing the value of the new varieties of fruit in that section.

It was deemed advisable to utilize for that purpose the extensive experimental plantations of T. T. Lyon at South Haven. The necessary arrangements were therefore made with Mr. Lyon, and he has embodied the results of his observations during the past season in the following report.

It has been very carefully prepared, and the author's experience and ability in testing fruits will make it a reliable guide to the fruit growers of Southwest Michigan, and to an almost equal extent to those of the State at large.

L. R. TAFT, *Horticulturist.*

South Haven, Oct., 1889.

To Prof. L. R. Taft, Horticulturist, Experiment Station:

SIR—The arrangements for a branch or sub-experiment station, at this place, not having been effected till last spring, the planting for such purpose has only been commenced since that time, and cannot, therefore, afford useful results during the present season.

Much planting (especially of small fruits) more or less available for such purpose had, however, been previously done; including, also, considerable collections of apples, pears, plums, quinces, cherries, peaches and grapes, as well as a few nuts and other trees, each in considerable variety, selected in very many cases for testing purposes. These had been planted in the spring of 1888, and therefore have not yet shown fruit, and are, for the present, only useful in so far as they afford information respecting vigor, hardiness, habit of growth, etc.

APPLES (*Pyrus malus*).

Forty varieties of the apple have now been planted, of which twelve are of Russian origin, nearly all of which are varieties imported by Professor J. L. Budd, of Iowa.

None of these have suffered from the attacks of fungi, and the only injurious insects have been aphides, which in June appeared in such numbers as to threaten to wholly arrest growth. The spraying of the trees with an infusion of buhach at once arrested their attacks and growth was very soon resumed.

PEARS (*Pyrus communis*).

Thirty-seven varieties of pears have been planted, all on free stocks. Of these, five varieties are from the importations of Prof. Budd, of eastern European varieties.

So far as observed, these have not yet been attacked by either insects or fungi.

QUINCES (*Cydonia*).

The plantation included five varieties of the quince; none of which have yet fruited.

These were attacked in June by the slug, *selandria cerasi* Peck; but a single application of an infusion of white hellebore in water put a quietus upon their operations for the season.

PEACHES (*Persica vulgaris*).

Of this fruit, thirty-eight varieties are now growing, mostly in their second year. A considerable number of these also are varieties received for trial, while many others are comparatively recent, and, to this region, untested novelties.

Planted in rows with the foregoing are three apricots, one being an importation by Professor Budd from eastern Asia; the others, Russian varieties.

PLUMS (*Prunus*).

Of these there have been planted:

Four varieties of *domestica.*

Six varieties of Prof. Budd's importations, which are also, no doubt, of the *domestica* class.

Seven varieties of native, *Americanas.*

Three *Chicasas.*

Two Japan varieties.

One *Pissard.*

None of these, of course, have yet produced fruit, and none have suffered from insects or fungi, except that a few of the Budd varieties have dropped their leaves, though not to a serious extent.

CHERRIES (*Prunus*).

Of this fruit, twenty-seven varieties have been planted, among which are thirteen of those recently imported from eastern Europe by Prof. Budd. None of these have yet fruited sufficiently to warrant descriptions or comparisons.

GRAPES (*Vitis*).

Of these there have been eighty-seven varieties planted, mostly in 1888, a few of which are showing some fruit, although not enough for experimental purposes. They are mostly of *labrusca* parentage, or of hybrids, between *labrusca* and either *vinifera* or *aestivalis*.

Several of them are new, undisseminated seedlings, received from the originators or introducers for testing.

The past summer seems to have been more than usually favorable to the attacks of mildew, and it has attacked the foliage of a few varieties to an extent sufficient to seriously check their growth.

Anthracnose has also manifested itself upon one or more varieties: in the case of five plants of Vergennes, to such extent that they have been taken up and burned to prevent the dissemination of the disease.

NUTS.

Paragon chestnut was received from Pennsylvania and planted in the spring of 1888. It is evidently an early bearer, it having produced catkins freely during both seasons, without, however, showing fruit. Whether it is a native, a seedling of the Spanish, of the more recently imported Japanese, or a cross between two of these, is uncertain. It is claimed to possess the size and early bearing of the foreign and the superior flavor of the native.

Hathaway is a name temporarily applied to a very large and excellent, selected, native variety, grown by B. Hathaway, of Little Prairie Ronde, Michigan, seeds of which were received from him and planted in the spring of 1888. Several of these were transplanted the past spring and are growing finely.

Pecans (*Carya olivæformis*) are usually very difficult to transplant. Yearling plants were received and planted in the spring of 1888, but without success. We, however, received seed from Col. G. B. Brackett, of southeastern Iowa (near the nortern limit of the indigenous growth of this tree), last autumn, which were at once planted, where the trees are designed to remain. These have vegetated freely, and will be left exposed, to determine their ability to withstand the temperature of our lake shore winters.

ENGLISH WALNUT (*Juglans regia*).

Trees of this were received and planted only last spring, and have made a moderate growth. Although this tree has been known to stand here for several years and even to produce fruit, its hardiness must yet be considered doubtful. Trees have therefore been planted as a means of determining the question.

MULBERRIES (*Morus*).

Three varieties of this have been planted.

Russian mulberry (*Morus nigra?*), as received from a western nursery, proves to be of two varieties. Of one the fruit is dark, reddish purple; the other, creamy white. The fruit is freely produced, but quite small and of no value. The trees are of spreading, almost drooping, habit, and so far perfectly hardy.

New American (*M. nigra?*) is of upright, spreading habit, producing fruit abundantly, even when quite young. Although the fruit is larger and finer than that of the Russian variety, it appears to be mainly attractive to the birds. It is of medium size and nearly black when fully ripe.

Everbearing, or Downing as it is more commonly called, originated with the late Charles Downing, at Newburgh, N. Y., many years since, from seeds of Multicaulis (*M. alba*). It is scarcely hardy here at the lake shore. The fruit is much larger and finer than either of the foregoing, and ripens in succession for a considerable period, hence the name. In this latitude, in any but the most favorable locations, winter protection will no doubt be found indispensable.

BLACKBERRY (*Rubus villosus*) AND DEWBERRY (*Rubus canadensis*).

Both the plant and the fruit of the blackberry seem to have nearly, if not wholly, escaped the attacks of both insects and fungi during the season.

The injury from the cold of last winter, also, was comparatively slight, only three or four of the most tender varieties, such as Brunton and Dehring, having been perceptibly injured.

Most of the varieties appearing in the following tabulation were planted in the spring of 1888, and are therefore not yet fully in bearing. Still, a few of the notes are from older plants, for which reason another season is requisite to enable us to fully determine their comparative productiveness:

Number.	Name.	Plant.								
		Place of Origin.	Time of Introduction.	Habit as Indicative of Origin.	Earliest Bloom.	Earliest Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10.)	Hardiness (1 to 10).	Productiveness (1 to 10).
1	Agawam	------	------	u s	June 8	Aug. 1	Aug. 27	5	8–9	5
2	Ancient Briton	------	------	u	“ 6	“ 4	“ 30	8	8–9	10
3	Bonanza	------	------	u s	------	------	------	5	7	------
4	Brunton	------	------	u	June 16	July 29	Aug. 30	3	2	3
5	Dehring	------	------	t	“ 9	“ 27	“ 31	3	2	6
6	Dorchester	N. E.	old	u s	“ 9	“ 29	Sept. 3	4	3	4
7	Early Cluster	N. J.	1885	u	“ 14	Aug. 4	“ 1	4	6	5
8	Early Harvest	Ill.	1882	------	------	------	------	4	------	------
9	Erie	Pa.	1886	s	June 11	Aug. 1	Sept. 4	8	9–10	8–10
10	Freed	Mo.	------	u s	“ 11	“ 6	Aug. 29	3	5	1
11	Kittatinny	N. J.	1850	u s	“ 11	“ 1	Sept. 6	8	6	10
12	Knox	------	------	u	“ 14	“ 4	“ 5	4	5	4
13	Lawton	N. Y.	1845	s	“ 14	“ 7	Aug. 29	6	4	9
14	Minnewaski	N. Y.	1886	t s	“ 15	“ 5	Sept. 5	6	5	9
15	Nevada	------	------	u	“ 15	------	Aug. 30	5	3	------
16	Snyder	------	------	u	“ 7	Aug. 2	“ 30	5	10	9
17	Stayman's Early	Kan.	1882	u s	“ 9	July 28	“ 26	2	2	2
18	Taylor	------	------	s	“ 8	Aug. 3	Sept. 3	7	10	10
19	Wallace	------	------	s	“ 12	“ 5	“ 3	6	8	7
20	Western Triumph	------	------	t u	“ 9	“ 4	Aug. 29	6	9	10
21	Wilson (Early)	N. J.	1852	u s	“ 12	“ 1	“ 28	6	6	9
22	Wilson, Jr.	N. J.	1884	s	“ 8	July 30	“ 27	6	6	9
	Dewberry (*Rubus Canadensis*):									
23	Lucretia	Vir.	1884	tr	“ 8	“ 18	“ 15	4	3	8

The manner of origination of varieties, as well as the dates of their introduction or dissemination, are but rarely explicitly given. These particulars are therefore very generally omitted in the accompanying table:

ABBREVIATIONS USED IN THE TABLE.

Habit of Growth.		Form of Fruit.		Color.
s. spreading.	tr. trailing.	i. irregular.	ov. oval or ovate.	b. black.
t. tall.	u. upright.	o. oblong.	r. roundish.	

Number.	Fruit. Size (1 to 10).	Quality (1 to 10).	Firmness (1 to 10).	Form.	Color.	Remarks.
1	9	8	4	r o	b	Plants not yet bearing fully.
2	6	6	7	ov	b	Lacks slightly in hardiness.
3	--------	--------	--------	--------	b	Not yet fully in bearing.
4	4	10	5	r o	b	Generally winterkills at Lake Shore.
5	5	10	7	o ov i	b	Generally winterkills at Lake Shore.
6	4	10	10	o	b	Nearly out of cultivation.
7	6	10	5	r o	b	Does not yet show value.
8	--------	--------	--------	--------	b	Planted spring 1889—genuine.
9	10	10	4	r o	b	Very strong spines—almost trailing.
10	3	6	5	r	b	Valueless here.
11	10	10	5	o	b	The heaviest bearer this season.
12	7	7	6	r ov	b	Not yet in full bearing.
13	9	9	5	o ov	b	Sour until thoroughly ripe.
14	10	9	6	r ov	b	Not yet in full bearing.
15	--------	--------	--------	--------	b	But imperfectly tested.
16	6	10	4	r o	b	One of the hardiest.
17	2	8	5	r	b	Has nearly the habit of a dewberry.
18	7	10	4	r o	b	One of the hardiest and best.
19	9	9	4	r o	b	Very desirable for home use.
20	6	9	5	o r	b	Over bears and fruit runs small.
21	10	7	6	r o i	b	Plant needs winter protection.
22	10	7	6	r o i	b	Needs protection in winter.
23	10	8	4	o	b	Its trailing habit protects it.

The following include the more useful and valuable varieties, whether new or old, which appear in the foregoing table, and which have heretofore attracted public notice, or promise sufficient value to warrant future attention:

Early Harvest originated, several years since, in southern Illinois, where it is highly esteemed. It was disseminated by an eastern establishment, which, by some mishap, sent out large quantities of spurious plants under this name, which prove to be the Brunton, a very tender variety, and therefore worthless at the north. The genuine Early Harvest is alleged to be hardy, early, productive, and profitable.

Wilson and Wilson, Jr. are so nearly alike that a single notice may suffice for both, the latter being an alleged seedling from the former, by the late Wm. Parry, of New Jersey. Both are exceedingly productive, and the fruits very large, although not of the highest quality. The canes lack hardiness, and at the north must be protected in winter to insure regular crops.

Agawam has been some years before the public, and seems to have not attracted the attention it deserves. It is but slightly deficient in hardiness. Its vigor, size, and productiveness fit it admirably for either the family or the market plantation.

Erie is a new variety coming from Pennsylvania. It so closely resembles the Lawton that some persons consider them identical. A careful comparison during this season shows that the Erie has a decidedly more trailing habit, with the fruit fully as large as Lawton, but more regularly rounded in form. The Erie is also more hardy than Lawton, and has stronger and more troublesome thorns than almost any other variety we know.

Kittatinny made its advent soon after the Lawton, and was disseminated by E. Williams, the present secretary of the New Jersey Horticultural Society. It would probably still stand very near the head of the list were it not lacking in hardiness. Even at the Lake Shore it frequently partially loses its crop from injury during winter. During the present season it has produced a full crop at this place.

Snyder is a strong grower, as well as one of the hardiest of the class. The fruit is of fine flavor, but is decidedly deficient in size.

Taylor is also a vigorous grower, of very spreading habit. It is very productive, and nearly or quite equals Snyder in hardiness. The canes are pale yellowish green. The fruit is considerably larger than Snyder, and somewhat later.

Western Triumph is scarcely as hardy as Taylor or Snyder, although it is rarely injured by our Lake Shore winters. It bears too heavily, so much so that it must have rich soil and good cultivation to maintain the size of the fruit.

Early Cluster is a comparatively recent introduction from New Jersey. So far it has not proved specially early, nor has it shown the productiveness originally claimed for it. It must show decided improvement in this last particular to justify even its continuance upon our list.

Ancient Briton is understood to have come originally from Missouri. It is of medium hardiness and vigor, and very productive. It is superseded.

Minnewaski, originated by the late A. J. Caywood, of Marlboro, New York, can hardly be assumed to have yet established a reputation. So far, it displays valuable qualities as to hardiness, size, and quality. It seems likely to take prominent rank as a market variety.

Wallace, which hails from the west, is hardy and productive, of large size and very good quality. Valuable for both the family plantation and for market.

Lawton is too generally known to need description. Although by some alleged to be identical with the Erie, it ripens later and continues longer in season. It is also a decidedly more upright grower, and is, so far, less hardy.

CURRANTS (*Ribes rubrum, nigrum* and *aureum*).

Plantings of these were made in the spring of 1888, consisting of:

Eight varieties of reds (*rubrum*).

Two varieties of whites (*rubrum*).

Three black varieties (*nigrum*).

Crandall was also included. This is disseminated as a probable hybrid between the Missouri, yellow flowering (*aureum*), and the cherry currant (*rubrum*), but we are unable to discover in plant, foliage, flower, or fruit anything to warrant such assumption.

The imported currant worm, *Nematus ventricosus* (Klug), attacked the foliage to some extent, but the prompt application of an infusion of white hellebore in water, applied by means of a Woodason sprayer, pretty effectually subdued them, although the appearance of the second brood required a second application.

The currant borer (whether the native or the imported we are not now able to determine) proves to be a very serious enemy to currant culture here at the Lake Shore, since the only known method of subduing them is by cutting away and burning the infected branches, thus destroying more or less of the bearing wood for the following year. Fortunately, there is at least one variety—the Victoria—which, for some reason, is nearly exempt from such attacks.

The premature loss of their foliage during July and August, due, doubtless, to the attacks of fungus, is a malady to which all the red and white varieties are more or less subject, excepting only Victoria and Long Bunched Holland, which seem to be mainly exempt. The commencement of dry, warm weather in July, following the excessive rains of the previous period, seems to have afforded the occasion for such malady.

GOOSEBERRIES (*Ribes*).

The plantations of these, made in the spring of 1888, included the following:

Houghton, which, although claimed to be proof against mildew of the foliage, has, with us, but partially sustained such claim. It has also been subject, here, to a malady (possibly caused by a minute aphis) which effectually checks the growth of the shoots so attacked, and causes the leaves, at or near the tip of each branch, to become crumpled together in a compact mass.

Champion is a quite recent introduction, with long slender shoots like Houghton, though more spreading, and with more and stronger thorns. The fruit is no larger than that of Houghton. It holds its foliage perfectly, and continues its growth till late in the season.

These, we infer, may be referred to *Ribes hirtellum* Michx.

Downing and Smith are usually spoken of as natives. They are more liable to lose their foliage than are the former two; and from their more sturdy habit, their more thorny habit, and greater liability to loss of foliage in summer, as well as to the increased size of their fruit, there would seem to be good reason to suspect an admixture of foreign blood.

The plantation also includes the following varieties of foreign origin, viz.: Auburn, Early Orange, Industry, and Dougall's No. 10. We regret to say that, although all except the last have shown more or less perfect fruit, they appear to be alike amenable to the attacks of their potent enemy, mildew, the last especially so.

The currant span-worm attacked the gooseberry also, and yielded readily to the same insecticide.

RASPBERRIES (*Rubus*).

VARIETIES OF IDÆUS AND STRIGOSUS AND SUPPOSED HYBRIDS, INCREASING BY SUCKERS FROM THE ROOTS.

Although usually considered less hardy than the cap varieties, these seem generally to have come through the last winter with little apparent injury, excepting only such tender varieties as Brinckle, Herstine, and possibly a few others, supposed to be mostly or wholly of Idæus parentage.

The spring and early summer here were generally wet and cool, and therefore favorable to the development of fruit, so far as size and quantity are concerned. The weather more recently has been hot and dry. This change seems to have resulted in the development of several forms of fungus. Of these, Anthracnose, or Raspberry Cane Rust, *Glœosporium venetum* Speg., has been more or less common, and has in some cases seriously checked the growth of the new canes.

Quite recently a profuse powdery mildew has, to some extent, attacked the foliage of the Turner raspberry, with the result of checking its development when at scarcely more than half its normal size, although not, apparently, injuring its tissues; the result being, however, to check, if not wholly arrest, the growth of the shoot.

Insects have been but slightly troublesome to the raspberry. Early in the season the girdling and ovipositing of the raspberry cane borer, *Oberea bimaculata* Oliv., was occasionally observed; but this can scarcely be considered an injury, since the attacks were very rare, while the result usually was the shortening of the cane, followed by branching, and a consequently increased amount of bearing wood for the ensuing year's crop. The subsequent operations of the larvæ may be readily prevented by the prompt removal and destruction of the girdled portion of the cane, including the egg deposited therein. The wilting and drooping of the tips of the injured canes render their detection an easy matter.

The following embrace the most desirable or promising of those included in the tabulated list, arranged, as nearly as practicable, in the order in which they ripen:

Hansell is usually the earliest variety to ripen. Although the fruits are neither large nor of high quality, nor yet is the plant vigorous, still it is worthy of being planted, on a limited scale, on account of its extreme earliness.

Marlboro, originated by the late A. J. Caywood, of Marlboro, N. Y., has been put forward as a market variety. Although moderately vigorous and hardy, its productiveness and consequent value for this purpose can hardly be said to be yet fully established.

Turner has been too long and too generally known to require description. On strong, rich soil, and especially where superior hardiness is requisite, it may fairly be accorded the leading position among varieties of its class.

Reder originated in Southwestern Michigan. The plant is somewhat lacking in vigor, and produces comparatively few suckers, but in size and quality the fruit has very few, if any, superiors, or even equals, among the red varieties.

Brinckle (Brinckle's Orange) is a pure Idæus seedling, originated in a Philadelphia city garden, many years since, by the once noted amateur horticulturist whose name it bears. It is a prince among raspberries, so far as both quality and beauty are concerned, but, sad to say, it is also one of the most tender, and must have protection even in ordinary winters.

Superb is a New Jersey seedling, which was brought to notice at the same time with Hansell. It ripens very nearly with Hansell. The berry is much larger, often fully seven-eighths of an inch in diameter. It is high-flavored, like most of the *strigosus* class, to which it belongs; and the pips or grains are so loosely put together that it is difficult to pick the berries without crumbling. The color, also, is quite too dark to suit the popular taste.

Cuthbert is a native of Riverdale, New York. Although not entirely hardy, it is one of the hardiest of its class; which fact, together with its healthy, persistent foliage, its vigor and productiveness, and the pleasant flavor and superior handling quality of its fruit, have won for it a high position both as a family and a market fruit.

Golden Queen possesses all the desirable qualities of the Cuthbert, both of plant and fruit, which is bright yellow when ripe. It is said to have been discovered in a plat of Cuthbert plants, and is supposed to be a sport from that variety.

Herstine takes its name from its originator, a Mr. Herstine, of Pennsylvania. It lacks hardiness, and is also slightly deficient in productiveness; while in size, brightness of color, and also in quality, it can hardly be said to have a superior.

Caroline was originated at New Rochelle, N. Y. It is supposed to be a hybrid between Brinckle and a Golden Cap, and possesses several peculiarities apparently sustaining this assumption. It may be propagated by both suckers and "tips." It is extremely hardy, and enormously productive, too much so for the size and quality of the fruit, except under high cultivation. The texture of the fruit is quite too delicate to warrant its use for market purposes.

Brandywine is an old variety of unknown origin, which possesses valuable qualities for the market in both the east and the west. It has the unusual peculiarity that it can be left upon the plant, when fully ripe, for a considerable time without suffering essential injury.

The following list of varieties will afford a satisfactory supply for a family, while the surplus, if any, may be marketed if desirable:

First, Turner; second, Herstine; third, Golden Queen; fourth, Cuthbert.

If extra trouble in the way of winter protection can be afforded, the quality may be improved by the addition of the Brinckle.

RASPBERRIES, RED AND ORANGE,

Number.	Name.	Plant.									
		Class.	Place of Origin.	Time.	Earliest Bloom.	First Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10).	Hardiness (1 to 10).	Productiveness (1 to 10).	Fungi.
1	Brandywine	S	------------	old	June 16	July 18	Aug. 9	7	8	8	----
2	Brinckle	I	Pa.	1845	" 12	" 9	" 1	5	1	10	----
3	Caroline	H	N. Y.	------	" 11	" 12	" 5	8	10	10	----
4	Crimson Beauty	S	------------	------	" 11	" 10	" 3	7	7	7	A S
5	Cuthbert	S	N. J.	1870	" 10	" 10	" 12	10	10	9	A S
6	Eastern King	S	------------	------	" 10	" 10	" 7	6	8	5	----
7	Golden Queen	S	N. J.	1883	" 9	" 8	" 9	10	10	9	----
8	Hansell	S	N. J.	1877	" 5	" 5	" 5	4	10	5	----
9	Herstine	S I	Pa.	------	" 16	" 12	" 3	6	4	6	A
10	Marlboro	S	------------	------	" 10	" 7	" 7	7	9	8	----
11	Meredith	S	------------	------	" 11	" 20	" 12	6	8	4	----
12	Michigan Early	S	------------	------	" 10	" 7	" 7	6	9	7	----
13	Philadelphia	S	Pa.	------	" 13	" 12	" 9	7	10	7	----
14	Rancocas	S	------------	------	" 8	" 8	" 1	6	9	------	----
15	Reder	S	Mich.	1880	" 10	" 8	" 8	5	5	7	A
16	Reliance	S	N. J.	------	" 11	" 10	" 7	6	10	10	A S
17	Scarlet Gem	S	------------	------	" 8	" 7	" 9	6	8	5	----
18	Superb	S	N. J.	----	" 8	" 9	" 9	3	8	8	A
19	Surprise	S	------------	----	" 15	" 12	" 7	8	6	8	----
20	Turner	S	Ill.	------	" 10	" 8	" 5	9	10	5	D

ABBREVIATIONS USED IN THE TABLE.

Class.	Form.	Color.		Fungi.
I. Idaeus.	c. conical.	r. red.	b. bright.	A. Anthracnose.
S. Strigosus.	i. irregular.	p. purple.	d. dark.	D. Downy mildew.
H. probable hybrid.	r. roundish.	o. orange.	du. dull.	S. slight.
		l. light.	g. glossy.	

WHICH PROPAGATE BY SUCKERS.

Number.	Fruit.					Remarks.
	Size (Scale 1 to 10).	Quality (1 to 10).	Firmness (1 to 10).	Form.	Color.	
1	6	6	9	r	d r	Suckers very freely.
2	7	10	9	r c	o	Very tender. Requires protection.
3	8	8	4	r	l o	Increases by both suckers and tips.
4	9	6	6	r	d r	Berries often imperfect.
5	10	7-8	10	r c	r	Leading red market variety.
6	7	4	4	r	du r	Promises little value.
7	10	7-8	10	r c	o	Possibly a sport from Cuthbert.
8	5	5	7	r	d r	Chiefly valued for its earliness.
9	9-10	9-10	6	r	b r	Superior save as to hardiness.
10	9	6	7	r	du r	Originated by the late A. J. Caywood.
11	6		6	r	l o r	A beautiful fruit.
12	6	4	7	r c	r	First noticed in New Jersey.
13	4	4	5	r	d p r	Old. Nearly superseded.
14	3	--------	----------	r	r	Needs further trial.
15	8	9	8	r	r	Quality of fruit superior.
16	8	5	9	r	d r	A seedling of Philadelphia.
17	6	4	5	r	b r	Requires further trial.
18	10	7	5	r i	d g p	Crumbles badly in picking.
19	8	6	5	r c	d r	Crumbles badly in picking.
20	5-7	8-9	4	r c	r	Very hardy. Canes thornless.

RASPBERRIES,

VARIETIES OF OCCIDENTALIS AND SUPPOSED

ABBREVIATIONS.

Class.
O. Occidentalis.
H. supposed hybrid.

Fungi.
A. Anthracnose (*Glœosporium venetum*, Speg.)
D. Downy mildew of the foliage.

Number.	Name.	Plant.									
		Class.	Place of Origin.	When introduced.	Earliest Bloom.	First Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10).	Hardiness (1 to 10).	Productiveness (1 to 10).	Fungi.
1	Ada	O	Ohio	1889	--------	--------	--------	4	10	------	----
2	Beebe	O	N. Y.	1886	June 6	July 9	Aug. 3	7	10	9	A
3	Butler	O	Conn.	1887	“ 7	“ 11	July 31	3	10	5	A
4	Carman	O	Conn.	1887	“ 7	“ 11	“ 29	4	10	5	----
5	Centennial	O	----------	------	“ 7	“ 8	“ 31	7	10	8	A
6	Doolittle	O	----------	-----	“ 7	“ 8	“ 31	6	10	8	A
7	Domore	O	----------	1889	--------	--------	--------	4	---	------	----
8	Earhart	O	Ill.	1887	June 8	July 10	July 31	10	10	8	----
9	Florence	O	N. J.	1881	“ 8	“ 17	Aug. 5	6	8	8	A
10	Gregg	O	Ind.	1880	“ 12	“ 13	“ 5	10	7	9	A
11	Hilborn	O	Ont.	1886	“ 10	“ 12	“ 3	5	10	4	----
12	Hopkins	O	----------	------	“ 10	“ 10	July 31	7	10	7	A
13	Indiana	O	Ind.	1884	“ 10	“ 12	“ 31	8	10	5	A
14	Johnston's Sweet	O	N. Y.	1886	“ 10	“ 10	Aug. 7	6	10	9	A
15	Kellogg	O	Wis.	------	“ 6	“ 12	“ 2	8	10	6	----
16	Mammoth Cluster	O	----------	------	“ 12	“ 13	“ 5	9	10	8	A
17	Nemaha	O	Neb.	1883	“ 14	“ 13	“ 5	10	10	10	----
18	New Rochelle	H?	N. Y.	------	“ 9	“ 10	“ 1	7	10	7	----
19	Ohio	O	N. Y.	------	“ 6	“ 11	“ 5	7	10	10	A
20	Palmer	O	Ohio	1888	--------	--------	--------	8	----	------	----
21	Shaffer	H?	N. Y.	1880	June 10	July 10	Aug. 7	10	10	10	A
22	Souhegan	O	N. E.	------	“ 5	“ 8	July 31	7	10	8	----
23	Springfield	O	Ind.	------	“ 5	“ 7	“ 29	5	10	6	----
24	Tyler	O	----------	-----	“ 5	“ 8	“ 31	7	10	8	----

BLACK AND ORANGE.

HYBRIDS ROOTING FROM THE TIPS OF THE CANES.

ABBREVIATIONS.

Form.
c. conical.
i. irregular.
o. oblate.
r. round.

Color.
p. purple.
pu. pubescent.
s. slightly.
v. very.
b. black.
d. dark.
g. glossy.
o. orange.

Number.	Fruit.					Remarks.
	Size (1 to 10).	Quality (1 to 10).	Firmness (1 to 10).	Form.	Color.	
1	--------	--------	----------	----------	----------	Planted spring 1889.
2	4	5	8	r	o	Dirty looking brown when overripe.
3	5	6–7	7	r	g b	Received for trial from Mr. Butler, Conn.
4	5	5	8	r	b	Trial not satisfactory.
5	5	7	5	r	g b	Not comparatively valuable.
6	7	7	6	r	g b	The oldest, among the best early.
7	--------	--------	----------	----------	----------	Received for trial, planted spring 1889.
8	4–6	6	9	r	g b pu	Fall, ripening in September on new canes.
9	6	5	7	r	o	Color dirty brown when over ripe.
10	10	4	10	o	b pu	Lacks juice and quality, market.
11	6	6	8	r	b	Is probably not the genuine.
12	7	6	7	r	b pu	Profitable, generally satisfactory.
13	6–7	6	9	r	b	Received from E. Y. Teas of Indiana.
14	5	7	9	r	g b	Mild in flavor for a blackcap.
15	5	6	8	r	b pu	Is not relatively valuable.
16	7	8	7	r	b v pu	Still a good market blackcap.
17	10	7	9	r	b pu	Much like Gregg, but hardier and better.
18	8	8	5	r c	d pu	Has the hardiness and habit of a blackcap.
19	6	6	8	r	b	Very seedy, valued for drying.
20	--------	--------	----------	----------	----------	Planted spring 1889.
21	10	9	7	r i	p pu	Highly valued, especially for canning.
22	5	8	8	r	b	Valued for its earliness.
23	4	8	9	r	b	Practically identical with Davison.
24	5	8	8	r	b	Same practically as Souhegan.

The following, which embrace the more valuable of the tabulated varieties, are mentioned, as nearly as practicable, in the order of their ripening:

Souhegan and Tyler, although doubtless of separate origin, are practically identical, so far as the characteristics of both plant and fruit are concerned. They are more especially valuable as the first of their class to ripen, although, in fact, but two or three days in advance of the older Doolittle.

Beebe (Beebe's Golden) is really golden only when taken just at the right stage; when only a few hours past this, the color changes to a forbidding, dirty looking brown, which is a serious drawback upon its value even for the family garden.

Doolittle was the first variety of its class to attract public attention; and even yet the improvement upon it consists more in variation of the season of ripening than in any important improvement of other qualities.

Ohio is especially commended as being superior for evaporating purposes. Its superiority in this respect is believed to consist mainly, if not wholly, in the fact that the seeds are large, and for that reason constitute an unusual proportion of the desiccated residuum.

Earhart is a very vigorous variety, which produces a moderate crop of fruit upon the last year's canes at the usual season, and a second crop in September upon many of the new canes of the current year. This second crop is quite liable to be ruined by frost before full maturity. It will be mainly valued by the curious, and by those desirous of having this fruit out of its regular season.

Hopkins is understood to have originated in Missouri. Although not extensively known in Michigan, it proves successful and profitable here also.

Johnston's Sweet was brought out by Robert Johnston, of New York. It is a very productive black cap, of exceedingly mild flavor, and is, like the Ohio, valued for evaporating purposes, doubtless for the same reason.

Shaffer (Shaffer's Colossal) is, as its synonym imports, a very vigorous grower, even for one of its class. It is frequently spoken of as a hybrid, the chief evidence of which is the unusual color of the fruit, which, when fully ripe, is a very dark brown, and very pubescent. The fruit is very large; and its high, sprightly flavor renders it very popular for canning among persons who have learned its peculiarities.

Hilborn is a comparatively recent variety, originating in Ontario. That described in the tabulation is strongly suspected to be spurious. The genuine Hilborn is of large size, nearly as large as the Gregg, and of superior quality.

Gregg occupies the leading position as a market variety on account of its large size, productiveness, and good handling qualities. It cannot be rated very high so far as flavor alone is concerned.

Mammoth Cluster (McCormick) was the leading market blackcap till displaced by the Gregg. It appears to be rapidly going out of use.

Nemaha is a comparatively recent introduction from Nebraska. It has most, if not all, the valuable qualities of the Gregg, with improved flavor and superior hardiness. It seems likely to supersede that old favorite, even as a market variety.

As a desirable selection for a family plat we would name Souhegan (or Tyler), Hilborn, and Nemaha, with Shaffer for canning.

The foregoing will suffice also for a market plantation, with the possible substitution of Gregg in place of Hilborn.

STRAWBERRIES (*Fragaria*).

The plat from which the following notes are made was planted in the spring of 1888, and having supplied plants for the sales of last spring, some varieties had been dug very closely, leaving in some cases little beyond the old plants; while others had been left comparatively full—all being in matted rows. A comparison as to productiveness, by measuring the yield of each, was therefore impracticable. Such comparative yield has therefore been estimated, using for the purpose a scale ranging from one to ten. The same scale is also used to express the comparative vigor of varieties, hardiness of the plant, under the influences of the past year, together with the size, quality and firmness of texture of the fruit.

During the past season a new plat has been planted with reference to the repetition of these observations under more satisfactory conditions. This new plantation is especially arranged for convenience in referring to and comparing varieties, and the rows have been kept evenly filled, and the plants replaced where vacancies have occurred. Many of the newer or recently introduced varieties have also been included.

In the following descriptions, the letter B following the name of a variety indicates that it is bi-sexual or perfect flowering; P, that it is pistillate, or practically without pollen producing organs. B P is attached to a few varieties whose blossoms show so few anthers that their sufficiency for perfect fertilization may be considered doubtful. B P is also attached to certain varieties in which there is a still greater deficiency of anthers, and which, to insure complete fertilization, should be planted near a pollen supplying variety.

In the following tabulation the descriptions are extended across two opposite pages, and numbers are used to avoid difficulty in tracing the connection.

The form and color of the fruit are given by use of the following abbreviations:

Form.
b. Broad or compressed.
c. Conical.
d. Depressed or oblate.
i. Irregular.
l. Long.
o. Oval or ovate.
r. Roundish.

Color.
b. Bright.
c. Crimson.
d. Dark.
l. Light.
r. Red.
s. Scarlet.

The extent to which the plant is attacked by fungi is indicated as follows:

a. Clear.
b. Slightly spotted by *Sphœrella fragariœ*, Sacc.
c. Much spotted " "
d. Very badly spotted " "
e. General discoloration, perhaps from over-maturity.

The dates of origination are in most cases to be considered as merely approximate, many of them having been inferred from the dates of introduction, or from mere recollection of our first acquaintance with the variety.

STRAWBERRIES.

ABBREVIATIONS FOR THIS TABLE.

Fungi (Sphœrella fragariæ Sacc.).			Form.
a. clear.	c. much spotted.	e. general discoloration, perhaps from over maturity.	c. conical.
b. slightly spotted.	d. very badly spotted.		l. long.

Number.	Name.	Plant.									
		Sexuality.	Place of Origin.	Time.	Earliest Bloom.	First Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10).	Hardiness (1 to 10).	Productiveness (1 to 10).	Fungi.
1	Acme	P B	Conn.	1884	May 11	June 18	July 6	2	2	3	b
2	Alpha	B	Ont.	1881	" 8	" 12	" 4	6	9	8	b
3	Anna Forest	B	N. J.	------	" 11	" 24	" 8	7	7	7	d
4	Arnold's Pride	B	Ont.	1881	" 10	" 19	" 8	9	10	9	b
5	Belmont	B	Mass.	1880	" 13	" 24	" 8	9	10	8	b
6	Bidwell	B	Mich.	1872	" 7	" 17	" 6	9	10	9–10	a
7	Black Defiance	B	N. J.	------	" 7	" 18	" 6	9	7	6	b
8	Bomba	B	N. J.	1880	" 8	" 15	" 12	10	10	7–8	b
9	Boone (Daniel)	P	Ky.	1878	" 9	" 21	" 8	6	8	5	b
10	Boyden's 30	B	N. J.	1870	" 9	" 20	" 8	7	9	6	c
11	Bright Ida	B	Ont.	1881	" 9	" 19	" 10	9	10	9	c
12	Bubach No. 5	P	Ill.	1885	" 11	" 18	" 8	10	10	10	a
13	Burt	B	N. Y.	1887	" 13	" 18	" 10	6	10	4–5	c
14	Captain Jack	B	Mo.	1874	" 10	" 24	" 8	8	10	7	e
15	Champion	P	Pa.	1872	" 10	" 20	" 8	5	7	8	b
16	Charles Downing	B	Ky.	1860	" 9	" 23	" 8	9	10	8	b
17	Cheny (Col.)	P	N. Y.	1872	" 9	" 18	" 8	4	3	8	a
18	Clara	B	Ohio	1888	----------	----------	----------	----	----	----	a
19	Cloud	P	La.	1887	May 11	June 20	July 8	9	9	5	b
20	Cohanzick	B	N. J.	1884	" 9	" 17	" 8	4	3	5	a
21	Cornelia	B	Ohio	1882	" 9	" 22	" 10	3	7	6	a
22	Covill	B	N. J.	1886	" 8	" 13	" 6	10	10	8	d
23	Crawford	B	Ohio	1887	----------	----------	----------	----	----	------	b
24	Crescent	P	Conn.	1870	May 7	June 15	July 10	9	10	10	a
25	Crimson Cluster	P	N. J.	1882	" 12	" 19	" 6	6	4	5	a
26	Cumberland	B	Pa.	1874	" 9	" 18	" 8	9	9	8	d e
27	Dew	B	Mich.	1876	" 18	----------	----------	10	10	------	a
28	Dewey	B	Conn.	1883	" 8	June 19	July 6	3	2	3	b
29	Duncan	B	------------	------	" 7	" 19	" 8	8	8	4	d
30	Dutter	B	------------	------	----------	----------	----------	----	----	------	a
31	Earle	B	Tex.	1886	May 15	June 21	July 4	7	8	4	a
32	Early Canada	P	Ont.	1880	" 9	" 17	" 6	6	8	4	b
33	Emerald	B	Eur.	------	" 7	" 18	" 6	4	6	5	b
34	Eureka	P	Ohio	1884	" 15	" 20	" 8	7	8	7	a
35	Fairy	P	------------	------	" 7	" 19	" 8	4	10	8	c
36	Galceron	B	Ga.	1882	" 14	" 22	" 10	10	9	6	b

STRAWBERRIES.—CONTINUED.

ABBREVIATIONS—*Continued.*

Form—*Continued.*			Color.		
b. broad or compressed.	i. irregular.	r. roundish.	b. bright.	l. light.	r. red.
d. depressed or oblate.	o. oval or ovate.		c. crimson.	d. dark.	s. scarlet.

Number.	Fruit.					Remarks.
	Size (Scale 1 to 10).	Quality (1 to 10).	Firmness (1 to 10).	Form.	Color.	
1	6	7	5 to 7	r o	b c	Not yet disseminated. Not worthy.
2	4	8	4 5	o c	l r	Most prolific. Very early variety.
3	7	7	3 4	c	b s	Of little apparent value.
4	8	8	7 8	i c	l r	Excellent. Too pale for market.
5	9	10	6 8	l o	b s	A valuable variety for the home.
6	8-9	9	6 9	l c	b c	Better when grown in hills.
7	8-9	8	9 10	r b	d c	Very old; and generally superseded.
8	9-10	8	4 5	c	c	A seedling from Crimson Cluster.
9	6	5	5 6	r o	d r	Lacks productiveness; and too acid.
0	7	7	6 7	r c	d c	Still a good amateur variety.
11	8	8	7 8	r b c	l r	Too dull in color for market.
12	9-10	6	6	r b d c	b c	Highly prized as a market variety.
13	6	7	9	r d c	d r	May prove to be Captain Jack.
14	4	6	9	r c	b c	Fruit stems taller than foliage.
15	6	5	8 9	r c	d c	Still occasionally planted for market.
16	6	7	5 7	r c	d s	Still much planted for market.
17	6	8	5 6	r b c	b c	Now nearly superseded.
18	--------	9	8 10	r	b c	A trial variety, not disseminated.
19	6	8	9 10	r	d r	Plants set late last fall.
20	4-5	6	7 8	r	d r	So far shows little value.
21	8	9	8 9	r c	d s	Plant very deficient in vigor.
22	3-7	9	9	r	d c	Sets more berries than it matures.
23	--------	--------	----------	----------	----------	Planted late this spring.
24	7	6	6	r c	b c	Sometimes nearly self-fertilizing.
25	5-6	9	6	d c	d c	Superior flavor. Very unproductive.
26	9	7	6	d r c	l c	Always perfect in form and even sized.
27	10	6	9 10	b r c	d c	Planted last spring. Fruit enormous.
28	5	7	5	r	c	Not disseminated. Unworthy.
29	8	9	7	c	d r	A very old variety. No longer planted.
30	--------	--------	----------	r c	d r	Planted late last spring.
31	5	8	4	o	b c	A trial variety from Texas.
32	4	7	6 7	r b c	d c	A good early amateur variety.
33	5	5	4	b c	d c	Like most foreigners, not valuable.
34	8	7	7 8	r c b	d c	New, promising for market.
35	4	5	3	r	l c	Plant lacks vigor.
36	5	9	9	r c b	d r	Popular in northern Georgia.

STRAWBERRIES.—CONTINUED.

ABBREVIATIONS.

Fungi (Sphœrella fragariæ Sacc.).
a. clear.
b. slightly spotted.
c. much spotted.
d. very badly spotted.
e. general discoloration, perhaps from over-maturity.

Form.
c. conical.
l. long.

Number.	Name.	Plant.									
		Sexuality.	Place of Origin.	Time.	Earliest Bloom.	First Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10).	Hardiness (1 to 10).	Productiveness (1 to 10).	Fungi.
37	Gandy	B	N. J.	1885	May 16	June 19	July 12	10	10	9	c
38	Garibaldi	B	N. Y.	------	“ 10	“ 25	“ 6	7	2	3	a
39	Garrettson	P	------	------	“ 10	“ 19	“ 8	5	3	4	b
40	Gipsy	P	------	------	“ 7	“ 17	“ 8	5	10	3	d
41	Glendale	B	Ohio	1871	“ 12	“ 24	“ 12	8	9	3-4	b
42	Gold	P	Conn.	1884	“ 15	“ 19	“ 8	5	7	8	b
43	Goldsmith	B	Ohio	1877	“ 10	“ 18	“ 8	9	8	5	b
44	Hampden	P	Mass.	1884	------	------	------	----	----	------	b
45	Hathaway No. 3	P B	Mich.	1876	May 16	June 25	July 10	10	9	6	a
46	Hathaway No. 5	P	Mich.	1876	“ 12	“ 22	“ 8	9	8	7	a
47	Hathaway No. 9	P	Mich.	1876	“ 9	“ 21	“ 6	10	5	6	b
48	Haverland	P	Ohio	1884	“ 8	“ 14	“ 10	5	10	10	a
49	Henderson	B	N. J.	1880	“ 13	“ 19	“ 8	6	3	3	a
50	Hoffman	B	Md.	1885	“ 10	“ 17	“ 6	5	4	3	a
51	Indiana	B	Ind.	1875	“ 10	“ 23	“ 8	10	5	5	c
52	Itasca	P	Ind.	1886	“ 10	“ 23	“ 8	9	10	6	a
53	Jersey Queen	P	N. J.	------	“ 16	“ 19	“ 8	7	7	5	b
54	Jessie	B	Wis.	1885	“ 10	“ 17	“ 10	10	10	9	a
55	Jewell	P	Conn.	1882	“ 10	“ 18	“ 16	5	6	8	b
56	Jucunda	B	Belg.	1855	“ 15	“ 26	“ 10	7	10	5	d
57	Kentucky	B	Ky.	old	“ 12	“ 26	“ 10	10	10	7	e
58	Lady Rusk	P	Ohio	1887	------	------	------	----	----	------	a
59	Lida	P	N. J.	1883	May 9	June 18	July 8	6	10	10	b
60	Little No. 10	B	Ont.	1887	------	------	------	----	----	------	b
61	Logan	B	Ind.	1886	May 10	June 19	July 10	10	10	9	b
62	Longfellow	B	Ky.	1876	“ 11	“ 19	“ 8	9	9	5	c
63	Loudon’s No. 15	B	Wis.	1887	------	------	------	----	----	------	b
64	Louise	B	------	------	------	------	------	----	----	------	a
65	Maggie	B	Ont.	1881	May 8	June 18	July 8	6	7	10	c
66	Mammoth	B	N. J.	1886	“ 14	“ 19	“ 12	10	10	7	b
67	Manchester	P	N. J.	1876	“ 11	“ 22	“ 10	9	6	8	e
68	Martha	P B	Minn.	1886	“ 11	“ 20	“ 8	10	10	6	b
69	May King	B	------	------	“ 12	“ 17	“ 8	10	9	8	b
70	Miami	P B	Ohio	1878	“ 12	“ 20	------	----	----	------	a
71	Miner	B	N. J.	------	“ 7	“ 20	July 8	9	10	8	b
72	Monmouth	B	N. J.	1885	“ 16	“ 25	------	3	3	4	c

STRAWBERRIES.—CONTINUED.

ABBREVIATIONS.—*Continued.*

Form.—*Continued.*
b. broad or compressed. i. irregular. r. roundish.
d. depressed or oblate. o. oval or ovate.

Color.
b. bright. l. light. r. red.
c. crimson d. dark. s. scarlet.

Number.	Fruit.					Remarks.
	Size (Scale 1 to 10).	Quality (1 to 10.)	Firmness (1 to 10).	Form.	Color.	
37	9	9	8	r c b	d c	Profitable. Late.
38	7	7	5	l c	r	Utterly unprofitable.
39	5	5	6	r c	c	Not valuable here.
40	5	6	4	r c	l r	Not valuable here.
41	8	7	7	l c	d c	Like Kentucky, lacks productiveness.
42	7	9	7	r	d c	A good family berry.
43	10	9	8	o c	b c	First berries large. Soon became small.
44	--------	--------	--------	o	b r	Planted late in spring of 1889.
45	8	6	6	l c	b r	For trial. Not disseminated.
46	9	9	7	l c	c	For trial. Not disseminated.
47	6	6	7	r c	s	For trial. Not disseminated.
48	8	7-8	6	l c	s	Perfect in form, even sized, profitable.
49	6	10	8	o c	c	Superior flavor its chief recommendation.
50	4	8	8	r	d r	Valued in Maryland.
51	5	6	6	c	l c	Not productive enough for profit.
52	7	7	6	r	c	Later berries fail to develop.
53	8	8	7	r b	l r	Has generally proved unproductive.
54	10	6	7	r c b	d c	Very promising for market.
55	10	6	7	r c i	b c	Produces very few plants.
56	8	5	9	r c	b s	Needs hill culture and strong soil.
57	7	6	7	l c	b s	Late market.
58	--------	--------	--------	--------	--------	Planted spring 1889.
59	7	7	4	r c	b c	Sets too much fruit. Late berries poor.
60	--------	--------	--------	--------	--------	Planted late in spring of 1889.
61	7	7	5	r d c	b c	Has good qualities for market.
62	9	6	6	l c	c	First fruits large. Late ones imperfect.
63	--------	--------	--------	--------	--------	Planted late in spring of 1889.
64	9	9	8	o c	b c	Planted spring of 1889. Promising.
65	6	8	5	r o i	l s	Too dull colored to be attractive.
66	10	7	5	l c r b	b c	First fruits very large.
67	8	8	9	r d c	c	Exhausts itself by overbearing.
68	4	7	7	r d c	d r	Plant satisfactory. Needs farther trial.
69	4	7	5	r b c	l c	Can scarcely be called profitable.
70	--------	--------	--------	--------	--------	Planted in spring of 1889.
71	7	6	5	c	d c	Becomes cockscombed on strong soils.
72	8	7	7	c	d r	A failure here.

STRAWBERRIES.—CONTINUED.

ABBREVIATIONS.

Fungi (Sphrœrella fragariæ Sacc.).
a. clear.
b. slightly spotted.
c. much spotted.
d. very badly spotted.
e. general discoloration, perhaps from over-maturity.

Form.
c. conical.
l. long.

Number.	Name.	Plant.									
		Sexuality.	Place of Origin.	Time.	Earliest Bloom.	First Ripe Fruit.	Last Picking.	Vigor (Scale 1 to 10).	Hardiness (1 to 10).	Productiveness (1 to 10.)	Fungi.
73	Moore's Prolific	B	Mich.	1884	May 13	June 20	July 9	10	10	9	a
74	Mrs. Cleveland	P	Ohio	1887	" 7	" 12	------	9	----	------	a
75	Mount Vernon	B	------	------	" 12	" 23	July 12	10	10	9	b
76	New Dominion	B	Ont.	1875	" 8	" 18	" 8	7	8	5	c
77	Nicanor	B	N. Y.	1850	" 7	" 12	" 5	7	9	7	c
78	Norman	B	------	------	" 7	" 18	------	----	----	------	b
79	Ohio Centennial	P	Ohio	1888	" 9	------	------	9	----	------	c
80	Ohio	P	Ohio	------	" 15	June 27	July 12	5	10	8	d
81	Ontario	B	N. Y.	1885	" 11	" 22	" 8	9	7	7	a
82	Parker Earle	B	Tex.	1886	" 6	" 14	------	9–10	10	10?	a
83	Parry	B	N. J.	1880	" 8	" 19	July 8	7	6	8	b
84	Pearl	B	N. J.	1884	" 11	" 19	" 8	10	10	9	b
85	Phelps, *Old Ironclad*	B	------	------	" 8	" 18	" 6	9	9	7	c
86	Pineapple	B	Md.?	------	------	------	------	----	----	------	b
87	Piper	B	Ill.	1876	May 11	June 19	July 6	8	7	5	b
88	President	B	------	------	" 12	" 20	" 10	6	6	5	b
89	Prince (of Berries)	B	N. J.	1880	" 15	" 22	" 8	8	4	4	b
90	Richmond	B	Mich.	1883	" 10	" 26	" 10	10	9	6	b
91	Seneca Queen	B	N. J.	------	" 11	" 26	" 6	7	9	5	c
92	Sharpless	B	Pa.	1874	" 12	" 25	" 8	9	7	7	b
93	Shirts	B	Mich.	1875	" 11	" 18	" 6	10	10	5	a
94	Sucker State	B	Ill.	------	------	------	------	----	1	0	b
95	Summit	P	Ohio	1880	May 15	June 22	July 12	5	6	8	b
96	Sunapee	B	N. J.	1884	" 9	" 18	" 6	7	10	4	b
97	Surprise (Truitt)	B	------	------	" 9	" 21	" 10	8	8	5	b
98	Townsend No. 3	P	Ohio	1888	------	------	------	----	----	------	b
99	Townsend No. 19	P	Ohio	1888	------	------	------	----	----	------	a
100	Triomphe de Gand	B	Belg.	------	May 10	June 24	July 8	4	4	3	b
101	Unnamed (Little)	B	Ont.	1884	" 9	" 23	" 10	8	8	7	c
102	Vick (James)	B	Mo.	1882	" 12	" 21	" 8	7	10	8	b
103	Warfield No. 2	P	Ill.	1883	" 8	" 17	" 10	8	10	9	b
104	Warren	B	Ky.	------	" 11	" 18	" 6	4	4	4	b
105	Wilson	B	N. Y.	1860	" 7	" 18	" 9	9	10	9	c
106	Windsor	P	Mich.	1875	" 11	" 20	" 8	5	9	8	b
107	Wonderful	B	------	------	" 9	" 18	------	----	----	------	b
108	Woodruff No. 1	B	Mich.	1872	" 10	" 18	July 10	4	4	6	a

STRAWBERRIES.—CONTINUED.

ABBREVIATIONS.—*Continued.*

Form.—*Continued.*
b. broad or compressed. i. irregular. r. roundish.
d. depressed or oblate. o. oval or ovate.

Color.
b. bright. l. light. r. red.
c. crimson. d. dark. s. scarlet.

Number.	Fruit.					Remarks.
	Size (Scale 1 to 10.)	Quality (1 to 10).	Firmness (1 to 10).	Form.	Color.	
73	10	6	7	o b c	l r	Much like Jessie in plant.
74	-------	-------	-------	-------	-------	Received spring, 1889, for trial.
75	7	8	7	r c	b s	Late, valuable.
76	5	6	7	d c	b r	Nearly superseded.
77	4	9	4	r o c	r	An old seedling by Ellwanger and Barry.
78	-------	-------	-------	-------	-------	Planted in spring of 1889.
79	-------	-------	-------	-------	c	Received for trial spring of 1889.
80	6	4	5	r c	b c	Late, valuable for this, if at all.
81	9	8	6	b c	d s	Much like Sharpless. Very vigorous.
82	5-6	9-10	4	l c	b c	Planted late last fall. Stood perfectly.
83	9	9	8	r c	l c	Slightly lacking in vigor.
84	7	8	10	l c	c	A promising semi-southern variety.
85	5	7	6	r c	s	Prized for market by some planters.
86	-------	-------	-------	-------	-------	Suspected to be an old variety, renamed.
87	5	5	6	r c	b c	For market lacks productiveness.
88	4	7	6	r c	b c	Lacks productiveness.
89	7	10	9	r	l r	Persistently unproductive.
90	7	7	7	c i	b c	Fruits often imperfect.
91	7	8	6	r d	b r	An excellent family variety.
92	9	8	6	b c	b c	Better when grown in hills.
93	5	8	7	l c	d c	Not sufficiently productive.
94	-------	-------	-------	-------	-------	Utterly failed this year.
95	9	7	8	r c	d s	A fine amateur berry.
96	4	6	5	r c	d r	Of very little value.
97	-------	-------	-------	-------	-------	Of very little value.
98	-------	-------	-------	-------	-------	Received for trial spring 1889.
99	-------	-------	-------	-------	-------	Received for trial spring 1889.
100	7	9	9	r c	b r	Need strong land and hill culture.
101	7	7	7	l c	c	Received from Ontario without name.
102	5	9	10	r	d c	Rather small for the market.
103	5	7	4	r c	b c	Promising as a market variety.
104	5	8	6	r	d c	An amateur variety.
105	6	8	10	c	d s	Later pickings run small.
106	6	6	8 to 9	r c	d c	Apparently identical with Champion.
107	-------	-------	-------	-------	-------	Planted spring 1889.
108	8	6	8	l c	d c	Not productive enough for market.

No insect attacks have proved seriously injurious to strawberries during the present season, save that a few varieties were planted last spring in a small plat infested by cut-worms, which were persistently dug up and finally eradicated.

A very few leaf-rollers were observed, but they were too rare to require special attention.

Of fungi, the only one deserving special notice is *Sphærella fragariæ* (Sacc.), the development of which occurred too late in the season to seriously injure the fruit; although the young plants may, and doubtless will be, more or less injured thereby. The extent to which this disease is noticeable upon the old plants is indicated in the foregoing table in the column headed Fungi.

The following brief notices are added, of some of the older varieties thought worthy, and already attracting more or less attention, together with a few new varieties, which seem likely soon to do so.

Alpha is the result of a cross by the late Charles Arnold of Paris, Ontario, between a foreign variety—Dr. Nicaise—and the Wilson. It is very mild in flavor, and has so far proved the largest and most productive of the numerous very early varieties which we have heretofore tested. Bisexual.

Arnold's Pride comes from the same cross, as well as from the same batch of seed as the foregoing. Its tendency is to set too much fruit to be properly matured on any but rich soils. For the market it lacks brightness of color. Bisexual.

Belmont originated in Massachusetts. The fruit is of large size and of superior quality. It requires rich, deep soil, and high cultivation to insure satisfactory results. A superior family berry if well grown. Bisexual.

Bidwell is one of B. Hathaway's numerous originations, and is well worthy of hill culture, by means of which its tendency to excessive production of plants is suppressed and its energies directed to the production of fruit. Bisexual.

Bomba—a New Jersey seedling—is one of the very large berries. In ordinary cases in matted rows only the first specimens will be large. It should always be grown in rich, deeply prepared soil, and preferably, in hills to insure satisfactory results. Bisexual.

Bright Ida is also a result of the cross of Dr. Nicaise and Wilson by Charles Arnold, and comes also from the same batch of seed with Alpha and Arnold's Pride, all which have a family resemblance in both plant and fruit. It would doubtless be desirable as a market berry but for its dull color. Bisexual.

Bubach No. 5 has now been several years in the hands of general planters. It has acquired a high position as a market variety, although pistillate and somewhat deficient in both quality and firmness. It is one of the most valuable of the large varieties.

Burt, a supposed accidental seedling, recently discovered in northern New York, has so strong a resemblance to Captain Jack that it is strongly suspected to be merely a re-introduction of that variety, to which it surely has too strong a resemblance to justify the addition of a new name to the list. Bisexual.

Champion, an old variety from eastern New York, is an alleged progenitor of the Windsor, more recently brought to notice in Michigan. The two are to all appearance identical, and the variety is now almost universally known and spoken of by the latter name. It is still to some extent planted for market. Pistillate.

Charles Downing, one of our oldest varieties, a Kentucky origination by the late J. S. Downer, still holds a somewhat prominent position as both a market and family fruit. It is too well and generally known to need a description. Bisexual.

Clara is a new variety, received for trial late in the fall of 1888. We are favorably impressed by its performances so far. The plant is vigorous and healthy. It requires farther trial to properly show its value as a producer of fruit. Bisexual.

Cloud is also a new variety discovered in Louisiana, and already very popular there. It has been widely tested at the north during the past season. Another season's trial is needed with us, as doubtless elsewhere. to determine its status in regions so widely removed from its original locality. Pistillate.

Covill is a comparatively new early variety. Last year it proved unproductive and too small. This year it set an enormous crop, and the earlier berries were large and excellent; but later ones were small and imperfect, and still later ones were nearly or quite abortive. Bisexual.

Crawford, first disseminated this year, is one of the somewhat numerous originations of Matthew Crawford of Ohio, who deems it his most valuable production. Plants set late last spring show a vigorous habit, but have not yet produced fruit with us. Bisexual.

Crescent is too well and generally known to need description. With persons who grow strawberries for market, in matted rows, it is yet a prime favorite in spite of its pistillate character. Among the better class of cultivators it is less popular. Nearly pistillate.

Cumberland is generally known and valued for its large and always perfectly formed fruit, which only needs a little more firmness of texture and brighter color with increased productiveness to entitle it to stand in the front rank of both family and market fruits. Bisexual.

Eureka is the name of a variety rejected several years since. It is now applied to a new variety originated in Ohio. From a two or three years' trial, we regard it as valuable for market. Pistillate.

Gandy is a comparatively recent introduction which gives evidence of decided value as a late variety for general purposes. Bisexual.

Glendale, an accidental seedling from Ohio, stands next to Kentucky among the older varieties as a late market fruit. Bisexual.

Haverland is one of the very recent varieties which is attracting much attention. It has shown itself at least fully as productive as Crescent, of larger size and better flavor. The plant, also, is healthy and vigorous. It is pistillate.

Indiana, named for its native state, was sent out several years since as a market variety. Several years' trial shows that its position is a debatable one in this respect. Bisexual.

Itasca, recently introduced from Indiana, is, apparently, not likely to win a standing among profitable varieties; although possessing some desirable qualities both of plant and fruit. Pistillate.

Jessie has been extensively advertised and rapidly and widely disseminated. With the mass of growers its vigor of plant and the size of the fruit will doubtless render it permanently popular; while those who place quality first will need to look farther for it. The size of its later specimens can only be maintained on good soils by high culture. Bisexual.

Kentucky, originated many years since by the late J. S. Downer, of that State, can scarcely, even yet, be said to have a rival as a late market strawberry; although it decidedly lacks productiveness. Bisexual.

Lida was disseminated a few years since by the late Wm. Parry, of New Jersey. It sets an enormous crop of fruit, which it can only mature with rich, deep soil and good cultivation. Even with these it may be doubtful if it will fully perform its early promise. It is pistillate.

Logan comes from the same source as Itasca, to which a two years' trial shows it to be superior. The plant is very vigorous, and it promises well as a market variety. It is bisexual.

Louise is a very recent introduction, which is highly commended by those who have tested it. Our plants were only set last spring, and have borne too little to warrant an opinion respecting it. Bisexual.

Maggie is one of four crossbred seedlings by the late Charles Arnold, of Ontario. Like the others, it is a vigorous grower, an enormous bearer, mild in flavor, and lacking in color; and hence not adapted to market planting. A valuable family berry. Bisexual.

Mammoth was disseminated by the late Wm. Parry, of New Jersey, and his successors. The fruit is very large and the plant a vigorous grower, but the size of the later specimens diminishes rapidly unless well sustained by good soil, manuring and cultivation. Bisexual.

Manchester is still somewhat popular as a rather late and very productive variety. Its chief fault seems to be, that the plant becomes so exhausted by the maturing of the first season's crop, that the plantation needs to be renewed after the production of a single crop.

May King shows few, if any, kingly characteristics here. It does not fruit heavily, as compared with others of its season. It is commended in some quarters as a good fertilizer to plant among pistillates. It is strongly bisexual.

Miner (*Miner's Great Prolific*) is a New York or New Jersey seedling originated many years since, which has long stood very near the head of the market list of popular varieties. On light soils it is very satisfactory; on heavy or very rich soils the fruits are inclined to be badly misshapen. Bisexual.

Moore's Prolific (prolific is surplusage) is reported to have originated recently in Wayne county, Michigan. We planted it only last spring. It proves to be a vigorous grower. During the fruiting season we examined a row of this growing beside one of Jessie, of the same age. There was little, if any, difference in vigor or productiveness, nor yet in the size of the fruit, although there was a manifest difference of form; and we thought the Moore somewhat superior in flavor. Bisexual.

Mount Vernon is a variety disseminated many years since. On heavy soils especially it is eminently valuable as a late market fruit; while at the same time its quality will justify planting it in the family plat. Bisexual.

Ontario is very much like Sharpless, so much so that little would be lost by dropping one of them. The difficulty would be to decide which should be retained.

Parker Earle is a very recent new variety, originated in Northern Texas. Plants received and planted late last autumn came safely through last winter, with a slight mulch for protection; and although seriously injured the past spring by cut-worms, the plants have shown remarkable vigor, and give promise also of abundant productiveness. Another year's trial is necessary to fully determine the measure of its success. Bisexual.

Parry, after several years' trial, must be assigned the position of a superior family or amateur variety. The plant is only moderately vigorous, yet produces medium crops of large, fine looking fruit, of excellent quality. Bisexual.

Pearl is a comparatively recent variety, coming, if we mistake not, from Maryland. Here it has, during a two years' trial, developed good characteristics as a market variety, while its comparatively high quality renders it satisfactory for the family plat. The plant is abundantly vigorous as well as productive. Bisexual.

Seneca Queen, as we understand, is one of the Miner seedlings; originating, as the name implies, in New York. It is one of the most beautiful of strawberries; but its characteristics fit it more especially for the home plantation, in which, with proper care, it will be found very satisfactory. Bisexual.

Sharpless originated in Pennsylvania. It occupies a somewhat questionable position, as a market variety. Its fine size is highly satisfactory for this purpose; and with high cultivation, and especially in hills, it is fairly productive; but, with ordinary management, in matted rows, it lacks productiveness. In quality, it is one of the best of the large varieties. Bisexual.

Summit is one of M. Crawford's originations. The plant is somewhat deficient in vigor, as well as in productiveness. The fruit is very large, and, like the Cumberland, is always very perfect in form, even when overgrown. It is best adapted to the family plantation. Pistillate.

Vick (James) is, in both plant and fruit, so nearly like Captain Jack that one description would suffice for both, save that the Vick is slightly inferior in size. Bisexual.

Warfield No. 2 is a recent variety from Illinois, and bears the name of its originator. It is greatly to be regretted that this, as well as several others, has been permitted to go to the public with numbers attached to the names, since this greatly increases the liability to errors of nomenclature. Great productiveness and vigor are the special claims of its originator. A single season's growth and fruitage but partially sustains such claim. Pistillate.

Wilson may almost be said to have been the fundamental means of developing the now extensive interest of commercial strawberry culture. Its quality, when fully ripened, may fairly be termed excellent; but its popularity, as a market variety, grows more especially out of the circumstance that it colors very early, and may be gathered and put upon the market while yet firm enough to bear rough handling. More recently it is very commonly attacked by that troublesome enemy of the strawberry plant, the fungus—*Sphœrella fragariæ*—for which reason, together with the rivalry of more modern varieties, it is, to some extent at least, giving place to others. Bisexual.

Windsor is alleged to be of Michigan origin, and to have sprung from seed of a cross of Chas. Downing upon Champion, but the almost universal verdict of experts has been that the Windsor and Champion are identical. Although we have kept the two distinct, and have observed them carefully for years, we have been compelled to accept the above verdict. It is generally called for under this name, rather than Champion, but both appear to be going out of use. Pistillate.

Woodruff No. 1 originated fifteen or twenty years since at Ann Arbor, Mich. Although the berry is considerably elongated, unlike many others of that form, it ripens at the tip as early as elsewhere. It was at one time a popular variety at Ann Arbor, but has never been extensively planted elsewhere. It is likely soon to be wholly superseded. Bisexual.

For a family or farm garden, to be grown in matted rows, mere quantity being of less importance than quality, a good selection of five varieties from the foregoing lists would be Alpha or Covill for early, followed by May King, with Belmont and Parry for medium and late, and Mount Vernon to close the season.

If to be grown in hills for the use of the family, Alpha, Bidwell, Belmont, Sharpless, and either Mount Vernon or Kentucky would give a good succession.

For market, in matted rows, a profitable succession would be Crescent or Haverland with Miner as a fertilizer, Bubach No. 5 with Logan to fertilize it; closing the season with Mount Vernon, or perhaps Kentucky.

For market, to be grown in hills, a good succession would be Covill, Cumberland, Jessie, Sharpless, Mount Vernon and perhaps Kentucky.

UNIVERSITY OF ILLINOIS-URBANA
3 0112 112110249